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CLINICAL AND MORPHOLOGICAL CHANGES IN THE UTERUS DURING THE VARIOUS PHASES OF POST PARTUM PERIOD IN COWS

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Summary

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163 cows from the Black and White and Bulgarian Brown Cattle breeds, liable to slaughter, were investigated between post parturient days 1 and 50. Out of them, 77 were with a normal parturition (group I) and 76 – with retention of placenta (group II). All cows were submitted to gynaecological examination for determination of uterine horn length and diameter, uterine wall consistency, the presence of uterine content and fluctuations and the status of the uterine artery.

After slaughtering, in a total of 127 cows (67 from group I and 66 from group II), the weight of the uterus, the length and the diameter of the pregnant uterine horn were determined. In 13 cows (6 from group I and 7 from group II), the dimensions of uterine caruncles were determined. In another 13 cows (7 from group I and 6 from group II), uterine angiography was performed at different intervals of the post parturient period and the span of the uterine artery was measured. In 10 cows (7 from group I and 3 from group II) during in life phase, biopsy specimens for histological examination at different periods of the post parturient period were obtained.

It was found out that uterine weight, the diameter and the length of the pregnant uterine horn decreased up to post parturient day 30. The size of caruncles in cows with a normal parturition decreased rapidly and by post parturient day 7 their dimensions were 40% of those at day 1. In the cows from group II this process was delayed and the respective carucle size was 60% of that at day 1.

The rectal palpation of the uterine artery showed that the vibration disappeared up to days 4–5, and in cases of complications – up to days 8–9. The dimensions of the uterine artery at post parturient day 1 were on the average 15 ± 2.1 mm in the pregnant horn and 10 ± 1.6 mm of the opposite horn. The angiography demonstrated tangential and transverse cross-sections through highly convoluted spiral arteries.

On the basis of our results it could be suggested that the size of uterus was most indicative for its restoration after parturition.

Key words: blood vessels, cows, puerperium

INTRODUCTION

The duration of postparturient period in cows is usually controlled by gynaecological examination. For a more precise determination of uterine recovery, many authors perform an examination of morphological changes occuring during the puerperium (Erices and Eulenberg, 1986; Gier and Marion, 1968; Marion and Lovell, 1968; Marion *et al.*, 1968; Vanderplassche and Bouters, 1976; Wagner and Hausel, 1969).

The time of occurrence of the complete recovery of the uterus after the parturition is still disputable. According to

Petrov (1972), the epithelium in the intercaruncular space regenerates entirely up to post parturient day 14, while others consider that it is completed by post parturient day 19 (Archbald *et al.*, 1972) or post parturient days 21–24 (Johanns *et al.*, 1967). There are reports that the process ends 4–6 weeks after the parturition (Schultz & Grunert, 1961) or that the complete uterine recovery occurs by post parturient days 50-60 (Noakes, 1986). None of those authors reports data about the changes in the uterine blood vessels during the early puerperal period in cows.

The aim of the present study was to monitor the clinical and morphological changes in the uterine wall and the architectonics of uterine blood vessels during the puerperal period in cows with regard to puerperium control in cows.

MATERIALS AND METHODS

The studies were performed on 163 cows from the Black and White and Bulgarian Brown Cattle breeds between post parturient days 1 and 50, divided into 2 groups. The first group included 77 cows with a normal parturition and the second one − 76 cows with retention of the placenta. The gynaecological status of each cow was determined immediately prior to other studies including the diameter and the length of the pregnant uterine horn, uterine wall consistency, presence of uterine content and fluctuation, status of *A. uterina* by a rectal examination covering the entire period till to the complete uterine involution, although in different individuals.

In 153 cows liable to slaughtering, the interval after the parturition was determined prior to the slaughtering. Out of them:

In 127 cows (64 from the first and 63 from the second group), the weight (kg), the diameter and the length of the uterine horn (cm) were measured by post parturient days 1, 5, 10, 20, 30, 40 and 50. When uterine horn dimensions were evaluated, the rates of decrease in uterine weight as well as those of both the length and diameter of uterine horns were considered.

In 13 cows (6 from group I and 7 from group II), the dimensions of uterine caruncles in various phases of the postparturient period (days 1, 4, 7 and 14) were determined.

In another 13 cows (7 from group I and 6 from group II) at different postpartudient days (days 1, 4, 7 and 14), angiography was performed. Before slaughter, presence or lack of vibrations of the uterine artery and its probable span were determined by a rectal examination. After slaughter, a preliminary careful separation of genitalia together with *Ligamentum latum uteri* was made. Twenty-four hour later, blood vessels were washed via the uterine artery with isotonic NaCl solution. Then, a warmed (37 ^{o}C) suspension of Pb_3O_4 (minium) in 10% aqueous solution of gelatine was injected. After solidification of gelatine, radiography in dorsoventral view was performed and the radiographs were photocopied for measurement of uterine artery diameter.

In 10 cows (7 from group I and 3 from group II), during the in life phase, biopsy specimens were obtained at different post parturient stages. The material for histological study was fixed in 10% neutral formalin, Bouin's or Carnua's liquids, then dehydrated, cleared and embedded in paraffine. The cross-sections (3–5 μm) were stained with haematoxylin-eosin, orceine and 0.1% toluidine blue.

The data were statistically processed by the analysis of variance (ANOVA) procedure. *Post hoc* comparisons were performed with the least significance difference (LSD) test.

RESULTS AND DISCUSSION

The data for the uterine weight, the length and the diameter of the pregnant uterine horn, evidencing uterine recovery after the parturition, are presented in Table 1. During the first 5 days, an enhanced reduction of uterine weight occurred, that afterwards was still present up to day 30. Similar changes were observed for the length of the pregnant uterine horn − a rapid change towards regression for the first 5 days, followed by retardation (up to post parturient day 30). The changes in the diameter of the pregnant uterine horn were relatively even up to day 30. A statistically significant decrease was present in every consequent period up to post parturient day 30. The results for those parameters in later intervals were characterized by insignificant differences vs the values at day 30.

At post parturient day 1, in cows with a normal parturition the caruncles were with the following dimensions: 75 ± 3.4 mm length, 50 ± 3.6 mm width and 25 + 2.0 mm thickness (Table 2). By day 4, their dimensions were significantly lower, but with preserved consistency and margins (Fig. 1. By post parturient day 7, a weak projection of lysed caruncles was observed (Fig. 2) and the dimensions were 40% of those by day 1. In the cows from group II (with complications during the parturition), the margins of caruncles were clearly visible (Fig. 3). The rate of decrease in their dimensions was lower and by day 7 their size was 60% of the size measured by day 1. The statistical analysis revealed a significant influence of two factors: the group and time. In most cases, significant differences in carucle dimensions among the different periods of the study as well as between groups by days 4 and 7 were observed.

One of the differences in the interpretation of uterine changes during the puerperium is connected with the diagnostic value of the diameter and pulsations of uterine artery. When palpated rectally at the first post parturient day, the arterial diameter in both groups of cows was 14−18 mm. In a normal puerperium, the vibrations of uterine artery disappeared up to post parturient day 4–5. In cases of complicated puerperium, for instance pla-

Table 1. Average values of estimated uterine parameters in cows with normal parturition and normal puerperium (n=10; mean ± SEM)

Parameters	Post parturient days						
	1	5	10	20	30	40	50
Uterine weight, kg	10.80± 0.25 a	4.60± 0.18 b	2.20± 0.20 c	1.50± 0.10 d	1.20± 0.10 e	1.00± 0.15	1.00± 0.10
Pregnant uterine horn diameter, cm	10.80± 0.25 f	4.60± 0.18 g	2.20± 0.20 h	1.50± 0.10 i	1.20± 0.10 j	1.00± 0.15	1.00± 0.10
Pregnant uterine horn length, cm	10.80± 0.25 k	4.60± 0.18 l	2.20± 0.20 m	1.50± 0.10 n	1.20± 0.10 o	1.00± 0.15	1.00± 0.10

Significant differences at $p<0.001$: a vs b; b vs c, f vs g, g vs h, h vs i, i vs j, k vs l and l vs m; at $p<0.01$: c vs d and n vs o; at $p<0.05$: d vs e.

Table 2. Dimensions of caruncules (mm) in cows after the parturition (mean ± SEM)

Days	Parameter	Group I	Group II
1	*Cows (n)*	1	1
	Caruncles (n)	10	10
	Length	75.0 ± 3.4	75.0 ± 3.5
	Width	50.0 ± 3.6	50.0 ± 4.2
	Thickness	25.0 ± 2.0	25.0 ± 1.5
4	*Cows (n)*	2	3
	Caruncles (n)	30	30
	Length	50.0 ± 2.4 a	70.0 ± 3.4 e
	Width	25.0 ± 2.6 a	40.0 ± 2.7 e
	Thickness	15.0 ± 1.7 a	20.0 ± 1.4
7	*Cows (n)*	2	2
	Caruncles (n)	20	20
	Length	30.0 ± 2.0 ab	45.0 ± 2.8 cde
	Width	20.0 ± 1.6 a	30.0 ± 2.3 cde
	Thickness	10.0 ± 0.8 ab	15.0 ± 1.4 cdf
14	*Cows (n)*		1
	Caruncles (n)	nd	10
	Length	nd	20.0 ± 1.5
	Width	nd	15.0 ± 0.6
	Thickness	nd	nd

Significance within groups: a = $p<0.001$ vs day 1; b = $p<0.001$ vs day 4; c = $p<0.01$ vs day 1; d = $p<0.01$ vs day 1; Significance between groups: e = $p<0.001$ vs group I; f = $p<0.01$ vs group I; nd = not determined.

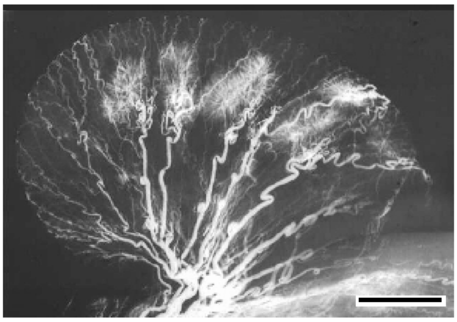

Fig. 1. Blood supply of caruncles at post parturient day 4. Bar = 21 mm.

Fig. 2. Blood supply of the uterus at post parturient day 7 in cows with normal parturition. Bar = 15 mm.

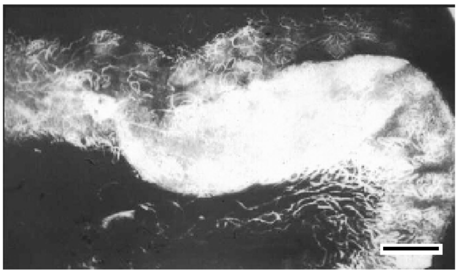

Fig. 3. Blood supply of the uterus at post parturient day 7 in cows with *retentio secundarium.* Bar = 14 mm.

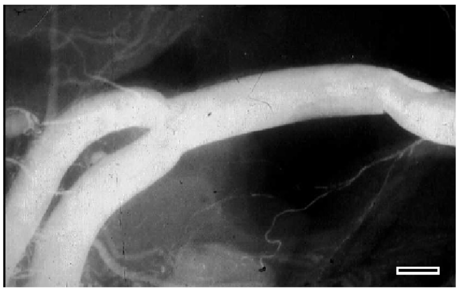

Fig. 4. *A. uterina* of the pregnant horn at the day of parturition. Bar = 15 mm.

Fig. 5. Spiral arteries (AS) in the basal layer of endometrium, toluidine blue. Bar = 50 µm.

centitis, the vibration of the artery persisted, most commonly 8-9 days after the parturition and in single cases up to the 14th day. The measurement made after slaughtering at the first post parturient day showed that the diameter of the uterine artery of the horn that was pregnant, was 15 ± 2.1 mm (Fig. 4) while that f the opposite horn − significantly lower (10 ± 1.6 mm). The ratio between arterial dimeters was usually 1.5:1 (pregnant vs. non pregnant horn). It was also observed that the thickness of uterine artery was correlating to the post parturient status: by day 4 it was 6.5 ± 1.0 mm and by day 7 − 4.5 ± 1.0 mm. In complicated cases, the value was higher by day 7 (7.5 ± 2.1 mm). Those data suggested that the changes in uterine artery dimensions could be used for a relatively precise determination of the course of uterine recovery after the parturition. Light microscope studies showed that the capillary network was very well developed including around the glandial parts located in *Stratum spongiosum* (Fig. 5). The characteristic findings in the same layer were mainly tangential and transverse cross-sections through highly convoluted spiral arteries. It must be emphasized that a greater rugosity was present in the material obtained 20 days after the parturition. Furthermore, the arterial lumen was smaller due to the thickening of the subendothelial layer.

Our results clearly suggest that the primary cause of decrease in uterine weight and dimensions after the parturition is the very restricted blood supply. This opinion of ours is similar to that of other investigators (Eulenberger, 1984; Gier and Marion, 1984). They reported that immediately after the parturition, a contraction and lysis of blood vessels of caruncles happened as a result of vasoconstriction and decreased blood supply. During the subsequent days, along with the decrease in oestrogens, the vasoconstriction involved the whole uterus and provoked muscle contraction because of the nearly triple reduction in muscle fibre volume. According to those authors, this is the reason for necrosis of superficial decidual cells overlaying the caruncles, whose destruction forms the detritus of lochia. This phenomenon is accompanied by absorption of the principal jelly-like matter and the content of oedema: debris of necrotized tissue, nutritive wastes – glycogen, lipids etc.

According to Kupriyanov (1983), the flow of blood in spiral blood vessels (arteries) in some organs (here, the uterus in a definite stage of the reproduction in cows) is a characteristic feature of the natural adaptation of the organism. The observed thickenings of the intima of spiral arteries as well as the spiral arteries themselves could be considered as structures, regulating the blood flow (Dimitrov *et al.*, 1997). This opinion is further supported by data from previous studies of Takada *et al.* (1987) and other authors that describe similar formations in other organs. It could be suggested that the vibration of the uterine artery was due to the greater blood flow as well as to the characteristic spiral architectonics of blood vessels that is most probably responsible for the turbulent blood flow during this period.

Angiographs showed that the dimensions of uterine blood vessels decreased up to days 14–21 (second phase of the puerperium). Then, some of the branches formed during the gestation become obsolete or disappeared completely 10-20 days after the parturition.

The data of our studies allowed to admit the presence of three puerperal stages: first (ending between days 7 and 10), second (ending between days 19-21) and third (after the 21st day). The dimensions of the uterus was most informative for the course of uterine recovery. Our data as well as those reported by numerous authors (Petrov, 1972; Boitor *et al.*, 1976; Gier and Marion, 1968; Marion *et al.*, 1968; Schltz and Grunert, 1961; Vandeplassche and Bouters, 1976; Wagner and Hansel, 1969) indicated that cows without a morphologically and functionally capable endometrium during the 3rd stage of the puerperium (up to post parturient days 25–28) have to be determined as animals with a pathological puerperium.

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