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Behavioural phenomena related to normal and difficult deliveries in dairy cows

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Abstract

Behavioural aspects of parturition, as well as the behaviour of cows and calves in the earliest post-partum period were studied in a group of 75 Polish Black and White cows. Distinction was made between unassisted deliveries, deliveries that required a little help (traction by not more than 2 persons) and difficult deliveries, requiring veterinary help. Of the cows 14 % gave birth while no behavioural signs of an approaching delivery were recognized before, 72% manifested clear signs of preparturient unrest and 70 % showed outflow of allantoic fluids before the calf appeared. A large variation was seen in the timing of these preparatory phases. Prolonged unrest, a cessation of labour and no appearance of the calf's feet were clearest signs that a difficult delivery would follow. After the appearance of the feet, only 48 % of the cows were able to expell the foetus within one hour. Spontaneous voiding of foetal membranes occurred characteristically within 12 hours postpartum.

Of the cows whose deliveries were unaided or aided, 86 % were in recumbent position during the final phase of expulsion of foetus. The majority (64 %) of cows with difficult delivery were standing.

Cows separated from their calves lie down earlier after calving than those kept with their newborn. From the latter category those after a difficult delivery spent most time licking their calves, partly in lying position.

After a difficult delivery calves started their first attempts to stand later, stood later, and when kept with their mothers, suckled later, than did other calves. The behavioural differences between calves from unaided and partly aided deliveries were small.

Introduction

Parturition is the natural process of giving birth to young in mammals and it is not

without risks to survival and health for both dam and young animal (Hoffmann et al., 1979). The real dangers of parturition are obvious in dairy cattle practise, where often the stockman has to assist the delivery or veterinarian help is necessary (Hoffmann et al., 1979; Meijering, 1984). Inadequate assistance can lead to reduced calf viability (Hoffmann et al., 1979) and may also disturb further reproduction of the cow (Vandeplassche & Bouters, 1982).

It is of great importance to look for criteria for estimating the difficulty of a delivery. The physiological process inside the dam is followed by exterior, physical and behavioural changes. Watching for these signs was the objective of several studies (George & Barger, 1974; Johnsson et al., 1980; Aitken et al., 1982; Kiley-Worthington & de la Plain, 1983; Schilling & Hartwig, 1984; Owens et al., 1985). However, no one has indicated how to estimate the degree of difficulty of the approaching delivery. Even the recognition of the imminent onset of parturition is difficult (George & Barger, 1974; Johnsson et al., 1980; Aitken et al., 1982; Schilling & Hartwig, 1984).

The events during delivery influence the behaviour of cow and calf immediately after delivery, the behaviour later and the likelihood of colostrum ingestion (Broom, 1983). Some authors have reported that a difficult delivery is reflected later by the maternal behaviour of the cow to her newborn (Selman et al., 1970; Kilgour & Dalton, 1984). The age of the mother can be a confusing factor here since heifers are often assisted at parturition; whilst some of the early behaviour of heifers towards their calves is a consequence of calving difficulties, some is due to lack of experience with calves (Edwards & Broom, 1982; Broom, 1983). Effects of difficulty of delivery on the calf can also be expected (Meijering, 1984). Several studies showed that parturitions that needed assistance diminished the viability of the newborn (Edwards, 1982; Herman & Stenum, 1982; Metz, 1984), and as a consequence its chances for survival (Owens et al., 1985).

The present study aims to contribute to knowledge about:
- the behaviour of the cow before and during parturition, especially to see if anomalous behaviour can indicate that help is needed;
- the behaviour of the dam and calf in the post-partum period in relation to the degree of difficulty of the parturition;
- some criteria for estimating the course of parturition. Insight into the behaviour during the course of delivery may reveal some possibilities for improving cow-calf treatment in the critical period during and after delivery.

Materials and methods

The experiment was conducted at the Krobów Experimental Station of the Agricultural Academy in Warsaw. Polish Black and White cows were used, 75 in total, served by the same Holstein Friesian bull. The cows were in their 2nd to 10th pregnancies. About one week before the calculated end of pregnancy, cows were brought into the experimental cowshed and loosely housed in individual delivery boxes of 2.5 m × 3.0 m provided with straw bedding. The cows were fed concentrates, silage or fresh cut grass, and some hay or straw.

After delivery the animals were assigned, on the basis of lactation number and available calf boxes, to one of the two experimental groups:
– *M-group*. Calves were kept with their mother in the delivery box for the total time of observation (47 pairs);
– *S-group*. Calves were separated from their mother immediately after delivery, put in individual calf boxes of 1.1 m × 1.3 m provided with straw bedding (28 pairs) and bucket fed.
All calves were weighed immediately after delivery. M-calves that did not suckle spontaneously within 4 hours post partum got some help in finding the mother's udder. S-calves got the own mother's colostrum from an open bucket within 4 hours post partum.

Observations of the stages of parturition of 64 cows were made. The following elements were discerned:
– 'Unrest' behaviour. This comprised behaviours typical of the start of parturition like looking and turning around, calling, licking the bedding material, lifting and waving the tail, frequent changes from lying to standing and vice versa, and frequent interruptions of eating. Unrest behaviour was recorded only when these behavioural signs appeared predominantly for 5 min.
– Outflow of allantoic fluids. Often the outflow of this yellow brown fluid occurred unexpectedly, i.e. without appearance of the allantoic sac in the vulva.
– Appearance of hooves of the calf at the vulva.
– Expulsion of the foetus.
– Voiding of the foetal membranes.
Cows placed in the delivery boxes were inspected at hourly intervals for a few minutes to check for the start of unrest behaviour or the occurrence of any of the subsequent stages. From the time the first symptoms of parturition were observed (unrest, or eventually outflow of fluids or appearance of hooves), continuous observations were made until the end of the delivery. Voiding of foetal membranes was recorded on the basis of inspections at 15-minute intervals.

Deliveries of the 75 cows were categorized according to their degree of difficulty, in three groups:
– Unaided deliveries (U-deliveries). The calves were born without any human help.
– Aided deliveries (A-deliveries). The birth of the calf was assisted by traction, maximally by two persons. Such help was given one hour after hooves of the calf appeared at the cow's vulva.
– Difficult deliveries (D-deliveries), where the parturition did not make further progress after occurrence of the first stages, either because the hooves of the calf did not appear, or when traction by two stockmen was not sufficient to draw the calf from the mother. Difficult deliveries were always under veterinarian control.

Of 35 M-cows and 47 M-calves, and 28 S-cows and 28 S-calves behavioural observations were made for four hours after calving. The following elements were distinguished:
– in all cows: standing and lying;
– in M-cows: licking the calf;

– in all calves: attempts to stand up, and standing;
– in M-calves: looking for the mother's udder, i.e. orientation towards the mother and movements which might result in contact between the nose and the cow's udder or similarly located body parts, and suckling.

In the statistical analysis, the parametric tests were according to Sokal & Rohlf (1981) and the non-parametric tests according to Siegel (1956).

Results

Stages of parturition

Table 1 shows the variation in the occurrence of different elements of parturition, as observed within the group of 64 cows. In this group, 9 animals (14%) gave birth between two inspections, while none of the exterior signs was noticed at any inspection before. These cows were said to have 'spontaneous' parturition. The deliveries were classified as U-deliveries.

Table 1. Different stages and the course of parturition according to the number of cows, which were involved. D means difficult delivery and A partly aided delivery.

Stages of parturition	Number of cows		
	total	D	A
Completed parturitions	64	11	20
Not observed, 'spontaneous' parturitions	9	0	0
Stage of unrest (n = 55)			
No unrest observed	9	3	1
Unrest, followed by cessation of labour	1	1	0
Unrest, lasting > 24 h	3	3	0
Unrest, but outflow of allantoic fluid not observed	7	2	3
Unrest, outfow of allantoic fluid next sign	35	2	16
Outflow of allantoic fluid (n = 55)			
No outflow observed at all	9	3	3
No outflow seen within 24 h after unrest started	1	1	0
Outflow of fluid, followed by cessation of labour	2	2	0
Outflow of fluid, but during expulsion of foetus	4	2	1
Outflow of fluid, appearance of hooves the subsequent sign	39	3	16
Appearance of hooves (n = 55)			
No spontaneous appearance of hooves	5	5	0
Appearance of hooves, expulsion of foetus unaided	24	0	0
Appearance of hooves, delivery with help	26	6	20
Voiding of oetal membranes (n = 64)			
Membranes detached by veterinarian	15	6	3
Membranes voided under influence of drugs	3	3	0
Membranes detached spontaneously	46	2	17

Unrest as a distinctive phase of parturition was noticed in 46 of the remainder of the cows (72 %), while in 35 of these cows (55 % of total) this was succeeded by outflow of allantoic fluids as the next, distinctive step. Altogether, the outflow of allantoic fluids was noticed in 45 cows (70 %), whilst within this group, a spontaneous appearance of hooves of the calf at the vulva was noticed as the subsequent sign of the approaching delivery in 39 cases (61 % of total).

Of the group of 55 cows, the hooves of the calf did not appear at the vulva spontaneously in 5 cases (8 % of total), so that veterinary help was necessary. In 26 of the remaining 50 observed cases, the expulsion of the foetus was delayed for longer than one hour after the spontaneous appearance of hooves, so birth help was given. After 46 of the 64 deliveries (72 %) the voiding of the foetal membranes occurred spontaneously. In other cases drugs were used or the veterinarian detached the membranes manually.

Table 1 shows, in relation to the different parturition stages, the number of deliveries that needed assistance (D- or A-deliveries). A high proportion of difficult deliveries was seen in cases that unrest was followed by cessation of labour, unrest lasted more than 24 hours, allantoic fluid was not seen within 24 hours after unrest started, or cessation of labour was observed after the outflow of allantoic fluid. No spontaneous appearance of the calf's hooves at the vulva resulted, inevitably, in difficult deliveries. The chances of aided and unaided deliveries in relation to the variation in the preparatory phase of parturition fluctuated more or less parallel.

Of cows in which the foetal membranes had to be detached by a veterinarian or membranes were voided under influence of drugs, 50 % were after a difficult delivery, while it was 4.3 % for cows which voided the membranes spontaneously. Aided and unassisted deliveries differed little in this respect.

Table 2 is a comparison of the occurrence of different stages of parturition as spontaneous, separately identified elements, in relation to the degree of difficulty of the delivery. The three delivery types did not differ significantly as regards fre-

Table 2. Relation between difficulty of delivery and occurrence of various stages of parturition as clearly discernible, spontaneously occurring elements, expressed as the percentage of cows involved. The χ^2-test compares the U-and A-deliveries with the D-deliveries.

Type of delivery	Total number of cows	Stages of parturition			
		unrest	outflow of allantoic fluid	appearance of hooves at vulva	voiding of membranes
Unaided					
– 'spontaneous'	9	–	–	–	82
– observed	24	79	88	100	
Aided	20	95	85	100	85
Difficult	11	73	64	55	45
χ^2		0.41	1.72	16.84	5.22
Significance		n.s.	n.s.	$P < 0.001$	$P < 0.05$

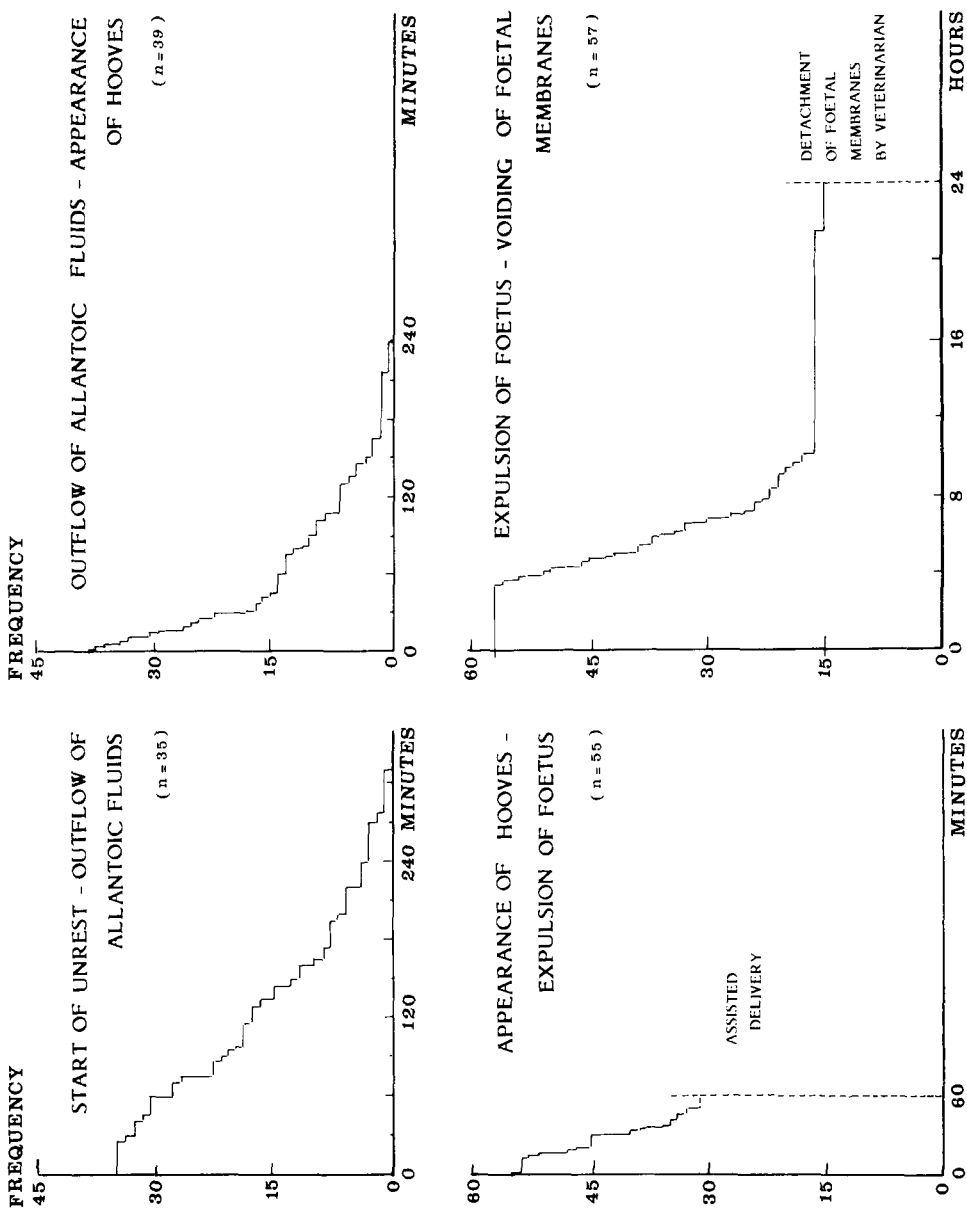

Fig. 1. Cumulative frequency distributions of the duration of different stages of parturition, plotted as survivorship curves.

quency of unrest and the outflow of allantoic fluids, but they did vary as regards the appearance of hooves at the vulva and the voiding of foetal membranes. In cows with a difficult delivery, the spontaneous appearance of hooves at the vulva and the spontaneous voiding of foetal membranes were less frequent.

The temporal basis of successive stages of parturition is shown in Fig. 1. Only data from cows in which the subsequent elements were clearly noticed were selected (cf. Table 1). The data on the voiding of membranes excludes cows treated with drugs and four cows voiding spontaneously (omitted observations). The time interval between first signs of unrest and the outflow of allantoic fluids varied in the selected cows between half an hour and 6 hours, and the interval between the outflow of fluids and appearance of hooves at the vulva varied between zero and 4 hours. In 16 cows with unaided delivery and 13 cows with aided delivery, the length of both successive intervals could be compared. In the first group, the interval between start of unrest and outflow of allantoic fluids lasted 122 min on the average and in the second group 143 min ($F = 0.49$, n.s.). The mean intervals between outflow of allantoic fluids and appearance of hooves at the vulva in the two groups were 42 min and 57 min respectively ($F = 0.59$, n.s.). The lengths of these two successive intervals (from unrest to outflow of fluids, from outflow of fluids to appearance of hooves) were not significantly correlated (for the both groups together: $r_s = -0.18$, $P = 0.17$).

The interval between the appearance of hooves and the expulsion of the foetus was often artificially shortened because birth help was given in cases where this interval would have exceeded one hour (Fig. 1). This occurred in 31 of the 64 cows (48.4 %). The voiding of foetal membranes occurred typically within 3½ to 10 hours post partum or a long delay was seen. Membranes not voided within 24 h post partum were detached by the veterinarian. In the cows with unaided deliveries the mean delay post partum before foetal membranes were voided was 5.0 hours, while in the cows with aided deliveries the mean delay was 5.6 hours (Student's $t = 0.68$, n.s.).

Finally, Table 3 shows the body position of cows during expulsion of the foetus. Cows not influenced by human help calved mainly in the lying position, but when help was given, a larger proportion of deliveries occurred while the cow was standing ($\chi^2 = 13.52$; $P < 0.01$).

Table 3. Position of cow's body during final expulsion of the foetus.

Type of delivery	Number of cows		
	total	standing position	lateral recumbency
Unaided[1]	24	2	22
Aided	20	4	16
Difficult	11	7	4

[1] 'Spontaneous' parturitions are excluded. $\chi^2 = 13.52$; $P < 0.01$.

Post-partum behaviour of cows and calves

The influence of the degree of difficulty of delivery on the behaviour of cows is shown in Table 4. Firstly, the period between delivery and first lying after the calving is compared. For the 8 cows in this experiment that did not stand up immediately after the delivery, but continued lying for at least one hour, an interval length of zero minutes was inserted for the statistical analysis. Of these cows, four had a difficult delivery and four were hampered by lameness. Lying down had to continue for at least 5 minutes in order to exclude from the data occasional cases where cows lay (fell) down and stood up immediately. Table 4 shows that S-cows lay down earlier after delivery than M-cows (for A- and U-deliveries, $F = 20.35$ and $F = 8.70$, respectively; $P < 0.01$). Further, M-cows after a difficult delivery lay down significantly earlier than those with a A- or U-delivery ($P < 0.01$). A similar trend existed in S-cows, but here the difference between the groups was not significant.

In M-cows, difficulty of delivery weakly affected total time of licking the calf within the first 4 hours post partum ($P = 0.05$) (Table 4). After difficult delivery cows licked longer, mainly because they licked significantly longer in a lying position ($P < 0.01$).

The influence of the type of delivery on the behaviour of calves in the first 4 hours post partum is shown in Table 5. The median lengths of intervals between birth and start of various activities were selected for presentation, because for calves that initiated a given activity after four hours, the actual time of starting this activity was not observed. A comparison of means was not possible, therefore. The median test was applied, in the M-calves on the basis of the three delivery groups, in the S-calves on the basis of two: D- and A-deliveries vs. U-deliveries. Significant influences were established for time of first standing, time of first looking for the udder and time of first suckling in M-calves, and time of first standing in S-calves. In every

Table 4. Behavioural differences within the groups of M- and S-cows, related to difficulty of the delivery.

	Type of delivery			Fisher's test	
	difficult	aided	unaided	F	P
M-cows	($n = 7$)	($n = 14$)	($n = 14$)		
Interval from delivery to first lying period >5 min (h)	0.8	2.0	1.9	8.01	< 0.01
Licking calf within 4 hours post partum (min)					
– total	113	99	83	3.23	= 0.05
– in standing position	77	92	77	1.56	n.s.
– in lying position	36	7	6	14.33	< 0.01
S-cows	($n = 3$)	($n = 15$)	($n = 10$)		
Interval from delivery to first lying period >5 min (h)	0.3	0.5	0.8	2.31	n.s.

Table 5. Median length of the time intervals between birth and the start of various activities in M- and S-calves in the three different delivery groups.

	Type of delivery			Median test	
	difficult	aided	unaided	χ^2	P
M-calves	(n = 7)	(n = 15)	(n = 25)		
First attempt to stand up (min post partum)	29	16	13	4.19	n.s.
First standing up (min post partum)	164	50	45	8.63	<0.05
First looking for the udder (min post partum)	>240	62	65	6.28	<0.05
First suckling (min post partum)	>240	131	116	6.44	<0.05
S-calves	(n = 3)	(n = 15)	(n = 10)		
First attempt to stand up (min post partum)	59	30	22	0.10	n.s.
First standing up (min post partum)	139	89	62	9.96	<0.01

case, calves which delivery had been difficult initiated the activities later. Table 5 reveals as a general trend that M-calves did their first attempts to stand up earlier than S-calves, while they were also standing earlier.

Another related factor which might influence a calf's behaviour is the duration of parturition i.c. the delay before emergence. The time interval between start of unrest and appearance of the hooves of the calf at the vulva was taken as criterion. Available data for 14 cow-calf pairs of the S-group showed a significant positive correlation between length of this interval and time from birth till first attempt to stand up by the calf ($r = +0.56$; $P < 0.05$) as well as time of calf's first successful standing after birth ($r = +0.49$; $P < 0.05$). Corresponding correlation coefficients in 21 pairs of M-cows and calves were not significant ($r = +0.05$ and $r = +0.29$, respectively).

Weight of calves

The mean birth weight of calves after difficult deliveries was 46.5 kg, that after aided deliveries 43.9 kg, and that after unaided deliveries 42.3 kg ($F = 3.34$, $P < 0.05$).

Discussion

Stages of parturition

This study deals with various phenomena related to difficult deliveries, but not directly with their causes. The extensive literature about causes of distocia indicates that morphological incompatibility between calf and dam and malpresentations are the main factors (Hoffmann et al., 1979; Meijering, 1984). Next are factors such as inadequate muscular activity in the cow, insufficient dilatation of the cervix, too

much fat deposition around the birth canal, and uterine torsion. The factors related to the preparatory stage of parturition may originate from external conditions and disturbances (Naaktgeboren & Bontekoe, 1976). Sejrsen & Neimann-Sørensen (1979) reported that calving difficulties of heifers decreased when they were brought from the tie stall to a calving pen one week before calving. This procedure was in essence followed in the present experiment.

The results support the idea that large calf body size increases the likelihood of a difficult delivery. Calves born after difficult deliveries were heaviest on the average, while those whose deliveries were unaided weighed least. In 5 out of 11 difficult deliveries calves were malpresented (2 cases of posterior presentation and 3 cases of lateral position of the calf's head) and in 3 cases the cervix was evidently insufficiently opened. Several difficult deliveries were preceded by very longlasting labour or a cessation of labour (Table 1).

Predicting the time of onset of parturition in cows is always considered most difficult. External physical signs, such as slackening of the sacrosciatic ligament, relaxation of the perineum and vulva, distension of the udder and discharge of mucus from the genital tract, all show large variation among cows, both in the time of appearance and the progression of these signs (Ewbank, 1963). In spite of this, Schilling & Hartwig (1984) conclude that the daily measurement of the relaxation of the pelvic ligament is a useful criterion, more precise than the other visual signs or palpation.

Behavioural signs of the imminence of parturition are very diverse and in the initial stage rather unspecific. Interruptions of eating and ruminating, aimless walking, increased alertness, increased aggressiveness towards herdmates, pawing the ground, bellowing, interest in alien calves, and isolation from the herd are among the earlier symptoms seen under paddock conditions (George & Barger, 1974; Johnsson et al., 1980; Aitken et al., 1982; Kiley-Worthington & de la Plain, 1983; Owens et al., 1985). When parturition comes nearer, the cows remain within a more confined area, and cycles of repeated lying down, standing, turning around, sniffing the ground and lying down again can be observed (Owens et al., 1985). These patterns also appear in cows kept indoors; they were important symptoms of initial restlessness as seen in the present experiment. Staring at the flank, swishing the tail, arching the back, and voiding of small amount of urine and faeces are behaviours which suggest that abdominal straining, i.e. labour, has started (George & Barger, 1974; Owens et al., 1985). Schilling & Hartwig (1984) proposed that the typical moving of tail for longer than two minutes is the most exact external sign indicating that parturition has commenced. This symptom was associated with opening of the cervix between 2 and 10 cm, while the foetal bladder was entering the vagina.

In this study 'unrest' behaviour did not give a consistent indication that parturition was imminent. Similar conclusions appeared from other studies (George & Barger, 1974; Johnson et al., 1980; Aitken et al., 1982; Owens et al., 1985). In our experiment, two facts were crucial. Firstly, a considerable number of cows did not show restlessness. Secondly, if restlessness was shown, a very variable period of time could follow before the next step (signs) of parturition appeared. Reports of

the duration of the preparatory stage of unrest have been: George & Barger (1974) 1-3 hours, Johnson et al. (1980) 159 minutes on the average for older cows and 80 minutes for heifers, and Owens et al. (1985) 97 minutes. These values are actually in the range of data presented here (Fig. 1).

The present experiment indicates that outflow of allantoic fluid also does not predict accurately the time of delivery. The appearance of the allantoic sac at the vulva is an unreliable sign, mostly because rupture of this sac can occur inside the birth canal. Further, the outflow of fluid may remain unnoticed, especially when cows are kept on deep bedding. Also the outflow can occur during the expulsion of foetus (Table 1).

After the outflow of allantoic fluids, the feet of the calf appeared at the vulva within four hours. In about fifty percent of cows it was within half an hour, which means that the large variation was actually due to a small number of cows (Fig. 1). One would expect that cows with the larger intervals were those with assisted deliveries, but our data did not confirm that. Also Schilling & Hartwig (1984) did not find differences between cows with unassisted or assisted deliveries in the length of the preparatory stage of parturition, which was said to end with the rupture of the amnion bladder. Only in primiparus cows that needed obstetrical help, did this stage last significantly longer. Owens et al. (1985) found a mean delay of 14 minutes between rupture of the allantoic sac and the appearance of the calf at the vulva.

In the present experiment, the delay between the start of unrest and and the outflow of allantoic fluid, and delay between the outflow of fluid and the appearance of the calf's feet at the vulva, were not correlated. This may be due to the very variable nature of the timing of single events of parturition. As Naaktgeboren & Bontekoe (1976) explain, such variations may be based on subtle interactions between the parturient animals and its environment.

Within the group of unaided deliveries in our experiment, the expulsion of the foetus, from the moment that hooves appeared at vulva, took 25.4 minutes on the average. This is in agreement with the findings of others. Johnson et al. (1980) reported 28 minutes for cows and 40 minutes for heifers, Jana et al. (1983) reported 25 minutes as an average, and Owens et al. (1985) 30 minutes. Of course, there is much variation among cows. In the present experiment, assistance was given when the calf was not delivered within one hour of its appearance at the vulva. A similar criterion was used by Jana et al. (1983) while Schilling & Hartwig (1984) waited 70 minutes from the time of rupture of the amnion bladder. The frequency distribution for the duration of expulsion of the foetus (Fig. 1) reveals that there is no reason to give help until one hour after the appearance of the feet of the calf at the vulva. The slope of the curve suggests that it would be better to wait even longer, as a large proportion of cows could be expected to complete delivery in the next hour without any help. It should be considered bad practice to give help before the birth canal is well opened.

The final stage of parturition, the voiding of the foetal membranes, occurred in most animals in the present study at a very characteristic time interval after delivery: between 3½ and 10 post partum (Fig. 1). Johnsson et al. (1980) reported for pure Herefords heifers and Hereford crossings mean values as short as 177 minutes,

and Edwards & Broom (1982) report values for Friesian cows of 2-6 hours. Times reported by George & Barger (1974), Jana et al. (1983) and Schilling & Hartwig (1984) are in the range of values found in this study. In our experiment, the foetal membranes were detached by the veterinarian when spontaneous voiding did not occur within 24 hours. The same time lapse is suggested by Jana et al. (1983). This time is outside the variation range of normal, spontaneous voiding times (Fig. 1), and seems therefore a good criterion.

As regards the order and temporal development of the stages of parturition this study reveals little difference between the cows with unassisted deliveries and those given some aid (traction by not more than two persons). On the other hand, parturitions which ended in a difficult delivery could in several cases be recognized beforehand by some deviations from the expected, normal course e.g. the stage of unrest was very long, a cessation of labour was observed, or the feet of calf did not appear at the vulva within some time period after previous phases (Table 1). It means that careful observations of (pre)parturient cows can help the stockman in identifying part of the cows that need special help later. The observations may also help to establish the right time for assistance (Fig. 1), although the considerable individual variation in the temporal sequence of parturition symptoms must be taken into account.

The position of cow's body during the most difficult stage of parturition, the expulsion of the foetus, deserves attention as it is valuable to know the cow's preferences. George & Barger (1974) and Aitken et al. (1982) observed that almost all calves were born while the dam was in a recumbent position. In contrast, Kiley-Worthington & de la Plain (1983) and Owens et al. (1984) noticed in the field that many cows of beef breeds stood up after the anterior part of the calf had passed the vulva so that the posterior part emerged while the cow was standing. This standing is considered to make the final phase of expulsion of foetus easier (Craig, 1981). In the present study almost all unassisted deliveries were completed in a recumbent position. Possibly the size of the delivery box (3.0 m × 2.5 m) made it more likely that the cows would remain in lying position until the end. Among aided deliveries a few were completed in the standing position, but among difficult deliveries the majority of cows stood. The human interference cannot be ruled out as a factor in the case that cows stood up. Nevertheless, it can be assumed, on the basis of previous discussion, that by standing up the cows finished the expulsion more easily.

Post-partum behaviour

This study did not confirm the opinion that a difficult delivery decreases maternal interest of cows towards their calves, as suggested by Kilgour & Dalton (1984). The cows under observation all started maternal care of their calves immediately after the weighing, which was done directly after birth. Only one cow rejected her calf later on. In this case the aggressiveness of the mother began to increase during the attempts of her calf to stand up. After one hour the calf was removed when the mother began to threaten its life. The parturition of this cow required some assistance and the calf was born in posterior presentation.

In this study, after difficult delivery cows did not spend less but more time licking

their young, although the extra licking was from a lying position (Table 4). Another finding was that within each category of deliveries, cows kept with their calves spent more time in the standing position after the delivery than those separated from their calves. Both points suggest that the dam kept with her young tries to overcome her weakness after delivery in order to ensure the behavioural functions which are relevant for the calf in the early post-partum period. Important functions of the maternal behaviour are activating the calf to stand up and to suckle, and the establishment of individual recognition (Selman et al., 1970; Kiley-Worthington & de la Plain, 1983; Edwards & Broom, 1982; Metz, 1984; Metz & Metz, 1985).

The behaviour of calves reflected the difficulty of delivery much more than did that of the dams. Whether kept with their mother or separated, calves stood later after difficult deliveries. This result is in agreement with Edwards (1982) who found that calves stood later (77 min) after assisted deliveries than after unassisted deliveries (55 min). Difficult deliveries also caused a strong delay in first suckling of the mother-reared calves. Similarly, Derenbach et al. (1983) reported a delayed first suckling for calves of beef cattle born under dystocia and calves born from heifers. A serious consequence of the delay in suckling is the consequent inadequacy of ingestion of colostrum by the calf (Broom 1983). Fallon (1978) and Kim et al. (1983) indicated clearly the negative effects of this on the calf's acquired immunity in the earliest period of life.

In the present study, the early activities of calves from unaided and aided deliveries did not differ when the calves were kept with their mother, but a difference was found in separated calves (Table 5). This difference between both calf groups has relevance in relation to the correlation between duration of parturition (as measured from the time between onset of unrest and the appearance of hooves at the vulva) and the time of first standing in the calves. In the separated calves, a longer delay before first emergence resulted in a later standing time. In the suckled calves, no relation was found. Two points may be concluded from this comparison: a) an assisted or long-lasting parturition weakens to newborn calf, but b) the calf may overcome its reduced vigour due to the stimulation which it obtains from its mother. The effect of a long-lasting parturition may be explained from the hypoxic state and possible (pre-pathological) acidosis of the newborn at birth (Walser et al., 1979).

Calves kept with their mother are likely to be exposed to strong maternal influences, so that the course of the delivery has less influence on the initial post-partum behaviour. In addition to the effects of maternal licking (Edwards & Broom, 1982), the standing of cows seems to influence the time of standing by the calf (Metz, 1984). In the present experiment, after aided and unaided deliveries cows adequately stimulated their own young by standing themselves (Table 4). Standing by the dam is also important for teat-seeking. Hermann & Stenum (1982) noticed that heifer's calves did not show any regular patterns in their teat-seeking. This was explained by the fact that heifers in contrast to older cows did not stand up for their calves teat seeking advances. In our experiments the considerably delayed first suckling times of calves after difficult deliveries may be explained in the same way.

Selman et al. (1970) and Edwards (1982) propose that, for dairy cows, the conformation of the dam's udder is the most important factor affecting the time of first

suckling by the newborn calf. The results of this study emphasize that the difficulty of delivery, with its effect on the behaviour of both cow and calf, is also of considerable importance. Derenbach et al. (1983) and Broom (1983) also indicate that difficulty of delivery is an important factor. Additionally, Broom mentions cow disease, a lack of maternal experience, soreness of teats, calf deformity, calf injury and calf stealing as factors.

In conclusion, the present study indicates that 'spontaneous' deliveries and deliveries that require some traction (not more than two persons) are rather similar as regards the development of the parturition process as well as its consequences for the behaviour of cow and calf during the post-partum period. In contrast, the deliveries which were classified as 'difficult' were in several cases preceded by obvious deviations in the preparatory stage of parturition and resulted subsequently in adverse delays in the main activities of the calf. Good stockmanship is required in order to reduce the adverse effects of difficult deliveries. The results presented here also indicate that the prediction of the time of delivery on the basis of preceding behavioural symptoms is difficult because of the high variability in the sequential and temporal order of these overt signs.

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