

## Calving assistance influences the occurrence of umbilical cord pathologies treated surgically in calves

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**Abstract:** Ninety-two umbilical pathologies were surgically treated in Holstein, Aberdeen Angus, and Polled Hereford calves, both males and females, whose ages ranged between 2 and 8 months. The pathology diagnosis was performed considering the main anatomical elements involved in the umbilical cord, the inflammation progression, and the macroscopic characteristics of injuries. The umbilical cord pathologies were related to calving characteristics. The proportion of affected umbilical cords in calves born via assisted calving (77%) was significantly higher than that observed in calves born from normal parturition. The umbilical cord pathology of highest occurrence was omphalophlebitis (53.2%). A considerable proportion of infectious diseases of the urachus was observed (29.3%). First-degree omphalophlebitis was diagnosed in a major proportion of surgical cases (30.4%) and showed significant differences in relation to the more serious pathologies of third-degree omphalophlebitis (5.4%) and third-degree omphalourachitis (5.4%). The occurrence of umbilical cord diseases treated surgically was significantly higher in assisted calving (77%) than in eutocic birth.

**Key words:** Calf, omphalophlebitis, omphaloarteritis, omphalourachitis, dystocia

### 1. Introduction

Calving is critical in reproductive efficiency and calf management is essential in reducing economic loss in beef and dairy cattle (1). Calf losses from birth to weaning generally oscillate from 5.5% to 8.6% (2,3). In the United States, annual calf losses are estimated at 300 to 400 million US dollars (4). Dystocia is the most common cause of neonatal and perinatal death in calves, being directly responsible for more than 50% of beef calf deaths (5,6). Calves born from difficult births showed a clear increase in the mortality rate during the first 24 h postpartum (7). Additionally, live calves born from dystocia were 2.4 times more prone to suffer illnesses during the first 45 days of life, as compared to calves from natural births (8). In Argentina, reproductive losses observed in breeding herds at birth accounted for 3.4%, while losses from birth to weaning accounted for 6.3% (9).

Calf navel pathologies are linked to parturition hygiene conditions. In normal calving, after the rupture of the umbilical cord, the urachus, arteries, and umbilical vein normally retract into the abdomen, thus preventing environmental contamination. The risk of umbilical infection is increased in a cesarean section due to the clamping of the umbilical cord, retarding the normal retraction of the umbilical structures (10). In some cases,

the abdominal wall tissues around the navel are injured during parturition, allowing for a bacterial contamination of all or part of the anatomic components of the umbilical region. Omphalitis weakens the adjacent abdominal wall, causing an acquired umbilical hernia (10). In some cases, septic umbilical processes could be concomitant with congenital hernias, common defects in calves, especially Holstein, whose occurrence is about 4%–15% (11,12,13). This paper refers to 7 years of casuistic cases of umbilical affections with surgical resolution in male and female calves of dairy and beef biotype from farms located in Buenos Aires, Argentina. In this study, the occurrence of umbilical cord pathologies in calves was determined and related to calving characteristics.

### 2. Materials and methods

In this study, 92 calves with umbilical cord pathologies treated surgically by the authors over a period of 7 years (1998–2005) were considered. The calf breeds were Holstein (65%), Polled Hereford (25%), and Aberdeen Angus (10%). Their ages ranged between 2 and 8 months; 42.4% were males and 57.6% were females. All calves belonged to farms located in the northeastern region of Buenos Aires Province, Argentina. On all farms, data on sex, weight, and assistance type were recorded at calving.

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“Normal” calving did not require human intervention, calving “with aid” involved only manual traction with a maximum of 2 operators, and “difficult” calving required a correction of fetal static before the manual traction of 2 operators. Calves from cesarean sections were not included. The hygienic handling of umbilical cord remnants and the colostrum intake were similar in normal and assisted calving. A presumptive diagnosis, based only on palpation methods, was performed before surgery. Complementary methods, such as X-rays and ultrasonography, were not used. A classification of navel surgical diseases was developed considering the main anatomical structures affected, the extension of the inflammatory process, and the macroscopic characteristics of the injuries found during the surgical procedure. In turn, whether or not the inflammatory process was concomitant with an umbilical hernia was recorded. Local inflammation, with increased size, edema, and dark-red color in the navel and umbilical vein, was considered as first-degree omphalophlebitis; second-degree omphalophlebitis describes a similar process, with the additional presence of abscesses in the lumen of the umbilical vein. If there was also a hepatic umbilical abscess, it was considered as third-degree omphalophlebitis. The inflammatory processes that involved navel and umbilical arteries, unilaterally or bilaterally, with edema, distortion of section, and tissue browning were considered omphaloarteritis. An inflammatory process that involved the navel and the first third of the urachus-bladder zone was considered first-degree omphalourachitis; when the process affected the second third, it was considered second-degree omphalourachitis; and when the infection compromised the entire urachus extension and also affected the bladder, it was considered third-degree omphalourachitis. In

all cases, macroscopic findings in the urachus included edema, enlargement, and abscesses.

Most surgeries were performed under general anesthesia (14), but in some situations a chemical restraint supplemented with local anesthesia (15) was preferred. In all cases, the authors carried out a resection of the affected components from the umbilical cord using reference surgical techniques (16,17).

### 3. Results

The final diagnoses of the 92 cases of umbilical cord pathologies with surgical resolution can be observed in Table 1. The umbilical cord pathology with the highest rate of occurrence was omphalophlebitis (53.2%). A considerable proportion of infectious diseases in the urachus was observed (29.3%). The occurrence of different umbilical cord diseases was not equal in all cases. A variance analysis performed on these proportions allowed rejection of the hypothesis of equal proportions ( $F = 6.6, P < 0.01$ ). A subsequent Bonferroni test with multiple comparisons (with a significance level of 1%) detected the differences shown in Table 1. The proportion of cases of first-degree omphalophlebitis (a) significantly exceeded the third-degree omphalophlebitis proportion (b) and third-degree omphalourachitis (b). The proportions of cases of the remaining pathologies (ab) did not differ from previous ones. In 80% of the cases, the umbilical cord pathology was complicated by an acquired umbilical hernia.

The results of the umbilical diseases diagnosed in relation to calf sex and calving characteristics are described in Table 2. No differences between males and females were found in the occurrence of umbilical cord diseases treated surgically. The comparison between males and females was made through a chi-square homogeneity test that showed the following values:

**Table 1.** Occurrence proportions of umbilical cord diseases treated surgically.

Pathology	Cases					
		Degree	%	*	With hernia	
Omphalophlebitis	49 (53.2%)	1st	28	30.4	(a)	24
		2nd	16	17.4	(ab)	13
		3rd	5	5.4	(b)	4
Omphaloarteritis	16 (17.4%)		16	17.4	(ab)	10
Omphalourachitis	27 (29.3%)	1st	13	14.1	(ab)	11
		2nd	9	9.8	(ab)	7
		3rd	5	5.4	(b)	5

\*: Different letters indicate differences in the occurrence proportions of umbilical diseases.

**Table 2.** Umbilical cord pathologies treated surgically observed in male (M) and female (F) calves related to calving assistance.

	Normal		With aid			Difficult			
	M	F	M	F		M	F		
1st degree omphalophlebitis	3	5	8	3	6	9	5	6	11
2nd degree omphalophlebitis	1	3	4	3	3	6	2	4	6
3rd degree omphalophlebitis	0	0	0	1	1	2	1	2	3
Omphaloarteritis	2	2	4	2	4	6	3	3	6
1st degree omphalourachitis	0	2	2	2	3	5	2	4	6
2nd degree omphalourachitis	1	1	2	1	2	3	1	3	4
3rd degree omphalourachitis	0	1	1	0	2	2	1	1	2
Total	7	14	21	12	21	33	15	23	38

$\chi^2 = 2.44$ ,  $P = 0.79$  for normal calving,

$\chi^2 = 1.89$ ,  $P = 0.93$  for calving with aid,

$\chi^2 = 1.12$ ,  $P = 0.98$  for difficult calving.

Significant differences were observed regarding the calving assistance type in all studied pathologies. The proportion of umbilical cord pathologies in assisted delivery (77%) was considerably higher than in normal calving (sign test,  $P < 0.05$ ). This indicates that assistance at birth increased the incidence of navel diseases treated surgically.

#### 4. Discussion

Clinical evaluation of the umbilical region in field conditions, by external and internal palpation, allows for the diagnosing of the presence of pathologies involving all or part of the structures, such as the urachus, umbilical vein, and arteries. However, the scope of manual palpation without ultrasonography is limited because, in some cases, the actual extension of the process cannot be determined (18). In most of the studied cases, the definitive diagnosis was intrasurgical. Although no microbiological tests were performed, it was assumed that the umbilical inflammatory processes had a septic cause. Pyogenic bacteria, such as *Arcanobacterium*, *Streptococcus*, *Staphylococcus*, and *Escherichia coli*, colonize the umbilical cord remnants (19). A deficient maturation of the umbilical cord without a correct retraction of the vascular structures favors bacterial contamination (20).

The developed classification of umbilical diseases treated surgically defines the adequate technique, the extension of the resection, the difficulty degree, and the prognosis.

The highest proportion of umbilical cord surgical cases was first-degree omphalophlebitis, showing

significant differences in relation to more serious diseases such as third-degree omphalophlebitis and third-degree omphalourachitis. It was reported that urachal infection is the commonest umbilical disease (21). As a prominent finding, this study shows a higher proportion of omphalophlebitis than that of other lesions. Poor antisepsis of the umbilical cord at calving and a late veterinary consultation in an omphalitis case could favor septic contamination of the blood clots contained in the umbilical vein and could explain the high proportion of omphalophlebitis.

In this study, an urachal infection was observed in 29.3% of total umbilical cases with surgical resolutions. A similar occurrence (28.4%) of urachal infection was described by Kılıç et al. (22). Umbilical infections may result in a weakening of the adjacent abdominal wall and cause an acquired umbilical hernia, or sepsis and hernia may simply occur concurrently (23,24). Concomitant umbilical hernias were observed in 80% of the studied cases.

Defects in newborn assistance, even under normal calving conditions, can cause illnesses of varying severity and size in the umbilical area, as observed in the 21 surgeries performed in calves born naturally. The type of calving aid, either by traction or correction before traction, significantly increased the occurrence of umbilical cord pathologies treated surgically. An increase in obstetrical handling increased the severity of umbilical cord diseases. Therefore, extemporaneous aid deliveries, and especially premature maneuvers, do not allow for the maturation and regression of the umbilical cord anatomical structures that prevent its contamination. Inadequate traction applied to the calf can also produce inadequate and inappropriate pressure on the umbilical region. Over 50% of calf losses

could be avoided through timely, correct obstetrical assistance (25).

In conclusion, the characteristics of calving assistance are associated with the complexity of dystocia. Calving and umbilical cord pathological processes are closely linked. Human intervention at calving increases the occurrence

of umbilical cord pathologies treated surgically. Increased obstetrical handling and premature maneuvers increase the severity of umbilical cord diseases. Even though a considerable number of urachus diseases were diagnosed, the umbilical cord pathology with the highest occurrence was omphalophlebitis.

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