

Abortion and Calf Mortality in Danish Cattle Herds

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Agerholm, J.S., A. Basse, H.V. Krogh, K. Christensen and L. Rønsholt: Abortion and calf mortality in Danish cattle herds. Acta vet. scand. 1993, 34, 371-377. – The aetiology of abortions and calf mortality in 65 Danish cattle herds consisting of both dairy and beef breeds during a 1-year period is described. All observed aborted foetuses, still-born calves, and calves dying before 6 months of age were necropsied, and relevant microbiological examinations were performed. A total of 240 calves and 66 abortions were submitted corresponding to a calf mortality rate of 7%. The abortion frequency could not be calculated. 43% of the calves died at day 0, while 22% were aborted, 15% died during the first week of life, 9% died from 1 to 4 weeks of age, and 11% died at the age of 1 to 6 months. The most common cause was neonatal pulmonic atelectasis (stillbirth) followed by foetal infections, pneumonia, and septicaemia.

stillbirth.

Introduction

Economic losses due to calf mortality are of great importance in intensive cattle production. This is also the case in Denmark where the mortality rate among calves younger than 6 months has been approx. 13 per cent during the last decade (Andersen 1991). Even though calf mortality is a great problem, only few aetiological studies have been performed. Furthermore, the results obtained have been based on selected material as the investigations have either been based on material submitted for examination from herds with disease problems (Lauridsen 1987), on calves in specialized production units (Madsen 1984), or concerning specific diseases in certain age categories (Blom 1981).

The purpose of the present study was to describe the aetiology of calf mortality in Danish cattle herds based on systematical necropsy studies.

Materials and methods

Sixty-five cattle herds located on Zealand were selected for the study. Based on information from the herd owners, the number of heifers and cows was calculated to approx. 3,100 with a breed distribution of approx. 43% Danish Holstein-Friesian (SDM), 21% Red Danish Dairy breed (RDM), 22% Jersey, and 14% beef breeds. The selection of herds was based on three conditions: 1) The herd should be affiliated to one of 6 chosen veterinary practises, 2) if possible, the herd should be associated to the National Milk Record System in cases of dairy herds, and 3) the herd owner should be interested in participation throughout the period studied.

During a one-year period all observed aborted foetuses, all stillborn calves, and all calves dying or euthanased before the age of 6 months were submitted for necropsy. Calves slaughtered before 6 months of age were not

examined. Anamnestic information including central cattle registration number of the calf and its dam, date of birth, date of death, clinical symptoms, and treatment was submitted with the calf.

Necropsy procedures

Standard necropsy was performed, and tissue samples for histopathology were taken from all tissues with macroscopic pathological changes, and in most cases also from brain, lung, myocardium, liver, kidney, and ileum. Samples from placenta were taken when ever possible. The samples were prepared using routine laboratory procedures, and stained with haematoxylin and eosin. Additional staining methods were used on indication.

Microbiological procedures

Microbiological examinations were performed on tissues from all submitted calves in accordance with the normal procedures at the National Veterinary Laboratory and the State Veterinary Institute for Virus Research.

Other procedures

Data on calvings in dairy herds were obtained from the Danish Agricultural EDP Centre (LEC), while the number of beef breed calves born during the period surveyed was estimated on basis of herd size.

Results

A total of 306 calves and foetuses were submitted for necropsy during the period studied. Age and breed distribution is shown in Table 1. The number of calvings in herds associated to the National Milk Record System was 3,112 while the number in not recorded herds (3 dairy herds and 16 beef cattle herds) was estimated to 519 giving a total of 3,631 calvings. The total number of calves born was esti-

mated to 3,686 using a twin-birth rate of 1.5%. The rate of calf mortality from day 0 to the age of 6 months could be calculated to 7%. It was not possible to estimate the size of the population studied concerning abortions.

The number of stillborn calves and calves younger than 4 weeks submitted from herds affiliated to the National Milk Record System was compared to the number of dead calves belonging to the same age groups reported from the herd owners to LEC. This was done retrospectively to evaluate if all dead calves were submitted. The comparison showed that 247 calves were submitted while only 232 calves were reported to LEC. At least parts of this difference was probably due to a difference in the age groups compared, as the age of calves varies from 1 day to 4 weeks with an average of 2 weeks when reported to LEC. Therefore, calves dying after the monthly herd report has been submitted will be registered as being alive even though they may die later. Therefore, it seems as if almost all dead calves were submitted from herds affiliated to the National Milk Record System. This was probably also the case in herds not associated to the record system. Concerning abortions, 62 cases were both reported to LEC and submitted for necropsy. This coincidence was probably fortuitous as reports on abortions to the National Milk Record System are very inadequate in general. Furthermore, the number of submitted abortions was also inadequate as only large foetuses were received. Many early and midterm abortions were most likely not submitted. Therefore, frequency estimations on abortions were associated with large uncertainties.

Most calves died in connection to the birth (130 calves ~ 43%) followed by abortions (22%), and death occurring within the first week of life (15%). Only 21% of the deaths occurred in the following 5 months (Table 1).

Table 1. Age and breed distribution of submitted calves and abortions.

Breed	Age					Total
	< 0 days	0 days	1-7 days	1-4 weeks	1-6 months	
SDM	37	66	25	19	17	164
RDM	16	38	10	4	11	79
Jersey	11	9	10	4	2	36
Beef cattle	2	17	2	1	5	27
Total	66	130	47	28	35	306

SDM: Danish Holstein-Friesian, RDM: Red Danish Dairy breed.

However, breed variations were found. The number of submitted Jersey calves was equal in the first 3 periods (<0 days, day 0, and 1-7 days), while the mortality rate was highest at day 0 for the other breeds. The rate of submitted calves dying at day 0 was 40%, 48%, 25%, and 63% for SDM, RDM, Jersey, and beef breeds, respectively.

Based on pathological and microbiological findings a main diagnosis for each calf was established. The main diagnosis was the condition which was considered to have been the death cause or had given rise to euthanasia. The main diagnoses are shown in Table 2. Two or several pathological changes in different tissues were often detected especially in older calves. These were commonly of infectious aetiology. The submitted calves often had pronounced cadaverosis, especially in the summer months which in many cases limited the isolation of virus and the histopathological evaluation, especially of "cadaverosis sensitive" tissues, e.g. intestine and central nervous system.

Age < 0 days (abortions)

Abortions due to foetal or placental infection was detected in 25 cases. Most common was mycotic placentitis due to infection with *Aspergillus fumigatus* (10 cases) followed by infection with *Actinomyces pyogenes* (3 cases),

Bacillus licheniformis (2 cases), and bovine viral diarrhoea (BVD) virus (1 case). Unspecific infections were found in 9 cases. The diagnosis in these cases was based on identification of inflammatory changes in foetus or placenta. Congenital malformations occurred in 4 cases, while specific changes were not found in 19 single abortions and 9 cases of twin abortions. In many cases the submitted material was not optimal for diagnostic purposes due to either missing of the foetus or its membranes.

Age = day 0

The most common diagnosis was neonatal pulmonic atelectasis (NPA) which was found in 105 calves (81%). Seventy-six of these occurred in connection to single births while 29 occurred in association with twin pregnancies in which either one or both calves died at birth. Calves having NPA showed a relatively uniform pathoanatomical picture consisting of disseminated acute circulatory disturbances (oedema, congestion, and haemorrhage), partial or complete pulmonic atelectasis, and aspiration of meconium, squamous cells, and keratin. Columna fracture was diagnosed in 7 cases. However, specific search for that particular lesion was only performed during the last 9½ months of the study. The investigations performed in these cases are de-

Table 2. Main diagnoses for 306 calves and abortions submitted for necropsy.

Main diagnosis	Age				
	< 0 days	0 days	1-7 days	1-4 weeks	1-6 months
Mycotic placentitis	10	0	0	–	–
Bacterial foetal infection ¹	5	1	0	–	–
Placentitis/foetal infection ²	9	0	1	–	–
Neonatal pulmonic atelectasis	–	76	0	–	–
Neonatal pulmonic atelectasis ³	18	29	–	–	–
Columna fracture	–	7	0	0	0
Other birth associated lesions	–	5	3	0	0
Bovine viral diarrhoea virus infection	1	9	2	3	4
Pulmonic thrombosis/oedema	0	1	1	0	0
(Broncho)pneumonia, pleuritis	0	0	5	4	16
Septicaemia	0	0	14	7	1
Meningo-encephalitis	0	0	1	0	0
Polyarthritis	0	0	1	0	0
Osteomyelitis	0	0	0	0	1
Peritonitis	0	0	3	4	6
Hepatic abscesses	0	0	0	0	1
Enterotoxic colibacillosis	–	0	3	0	0
Enteritis/diarrhoea ⁴	–	0	8	5	5
Volvulus	0	0	1	1	0
Pyelonephritis	0	0	0	0	1
Congenital malformations	4	2	4	1	0
No major lesions	19	0	0	3	0
Total	66	130	47	28	35

1: Specific bacteria isolated, 2: Unspecific microbiological findings, 3: Associated with twin birth, 4: Except infection with bovine viral diarrhoea virus.

scribed separately (Agerholm et al. 1993). Other birth related lesions were identified as death cause in 5 cases. These consisted of subdural meningeal haematoma (1), liver rupture (1), renal haematoma (2), and multiple rib fractures with thoracic haemorrhage (1). Infections were present in 10 calves. Nine calves were or had been infected with BVD virus due to either presence of virus or specific foetal antibodies while 1 calf which was born 2 weeks before estimated date of birth, was infected with *Bacillus licheniformis*. Lethal congenital malformations were present in 2 calves.

Age 1 to 7 days

Most of the submitted calves in this age group died due to infections (78%). The most common condition was septicaemia which occurred in 14 cases. Specific pathogens were only isolated in 3 of these (*Escherichia coli* O groups 15 and 78), while pathogens were not found in 11 cases. In these cases the diagnosis was based on histopathological changes. Bronchopneumonia and pleuritis, including a case of aspiration pneumonia occurred in 5 cases. A number of other lesions was also detected (Table 2). The pathogens found in inflamed tissue were in general those commonly

isolated from diseased calves. This was also the case concerning the age groups 1 to 4 weeks and 1 to 6 months.

Age 1 to 4 weeks

According to the pathological findings 82% of the calves belonging to this group died due to infections. Specific pathogens were isolated from 2 cases of septicaemia (*Salmonella typhimurium* and *Escherichia coli* O group 78) while the diagnosis was based on pathological findings in 5 calves. Peritonitis occurred both as a primary lesion and secondary to omphalophlebitis and penetrating abomasal ulcers. A main diagnosis was not established in 3 calves which had pronounced cadaverosis.

Age 1 to 6 months

All calves submitted in this group died due to infections. The most common disease was pneumonia (46%) followed by a number of other infections (Table 2). *Salmonella dublin* was isolated from a calf with osteomyelitis and enteritis. 4 calves were or had been infected with BVD virus. The diagnosis was in 3 cases based on isolation of virus while the diagnosis was assumed in one calf which had cerebellar hypoplasia.

Discussion

The calculated calf mortality rate was lower than the mortality rate among Danish calves in general. This can be due to several circumstances of which the breed composition of the population studied is probably the most important factor. The composition of the population in this study differed from the Danish cattle population mainly due to a large proportion of beef cattle. Furthermore, the mortality rate varies considerably among cattle herds. *Sørensen & Østergaard* (1982) found a variation in calf mortality from 6.4% to 37.9%

studying 31 SDM and RDM herds during a one-year period while *Blom* (1981) found a variation in mortality from 0.7% to 15.2% studying calves 2 to 120 days of age. It is possible that farmers with well managed herds were more interested in participating than farmers with poorly managed herds. Such a selection could lower the mortality rate considerably. A difference in herd size in the population studied compared to the population in general could also influence the calculated mortality rate as the mortality rate varies approx. 1% from herds with 20-40 cows to herds with more than 100 cows (*Andersen* 1991).

Another important factor in studying calf mortality is geographic differences. A location of the herds on Zealand could have influenced the observed mortality rate as, e.g. salmonellosis occurs significantly more often in other parts of Denmark (*Nielsen* 1984). Salmonellosis was only diagnosed twice in the present study.

The observed differences between the mortality rate at day 0 and the other age groups studied and among the different breeds are in accordance with previous studies (*Andersen* 1991, *Sørensen & Østergaard* 1982, *Svane et al.* 1990). The mortality rate among different beef breeds at day 0 and up 30 days of age varies from 4.9% (Hereford) to 10.0% (Charolais) (*Hansen* 1993). The mortality of dairy breed calves at day 0 also varies. However, the difference between the large dairy breeds (RDM and SDM) and the Jersey breed is less than one per cent. The Jersey breed has the lowest calf mortality rate at first calving, while the mortality rate and second and later calvings is higher for Jersey calves than for other dairy breed calves (*Nygaard* 1992).

The causes of calf mortality were those which are found in bovine necropsy material in general. The main cause of calf mortality was NPA which is in accordance with other studies

(Sørensen & Østergaard 1982, Svane et al. 1990). This main group was divided into two groups for aetiological purposes separating single births and twin births. Even though the pathogenesis and the pathoanatomical findings were similar for both groups, a division into two groups is reasonable in discussing predisposing features. In veterinary practice stillborn calves are thought to die due to dystocia related hypoxia in general. However, the present study showed that approx. 20% of the calves died due to other causes of which birth associated traumatic lesions and foetal infection with BVD virus were the most common. Infectious diseases were the main aetiology of calf mortality in calves older than day 0. During the first week of life the main problems were related to septicaemia and enteritis/diarrhoea. The mortality rate then decreased during the next 3 weeks mainly due to a decreased number of calves with septicaemia, enterotoxigenic colibacillosis, and congenital malformations. During the next 5½ months a further reduction was observed, and the main cause of mortality was found to be pneumonia. The great importance of pulmonic infections in relation to calf mortality in Denmark has previously been described by Blom (1981) and Madsen (1984).

The present study confirms that the main causes of calf mortality in Denmark are stillbirth (NPA) followed by infectious diseases. The percentage of predisposing virus infections is probably underestimated due to the state of the material received. The study showed that a wide number of pathological changes were present, and that detailed investigations, including histopathology are required in evaluating the aetiology of calf mortality.

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Sammendrag

Abort og kalvedødelighed i danske kvægbesætninger

Årsagerne til abort og kalvedødelighed i 65 danske kvægbesætninger bestående af såvel malke racer som

kødkvæg racer gennem et år beskrives. Alle observerede aborter, dødfødte kalve og kalve, der døde inden 6 måneders alderen blev obduceret, og relevante mikrobiologiske undersøgelser blev foretaget. Der blev i alt undersøgt 240 kalve og 66 aborter svarende til en kalvedødelighed på 7%. Abortfrekvensen kunne ikke beregnes. 42% af kalvene døde på dag 0, mens 22% blev aborteret, 15% døde i den første leveuge, 9% døde i alderen 1 til 4 uger, og 11% døde i alderen fra 1 til 6 måneder. Den hyppigste dødsårsag var neonatal pulmonal atelektase (dødfødte kalve) efterfulgt af fosterinfektioner, pneumoni og septikæmi.

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