Mortality in mink kits from birth to weaning

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Abstract

In 1988, a necropsy survey of the pattern and major causes of mortality in mink kits from birth to weaning was undertaken. The overall preweaning mortality rate was 20%. Mortalities occurring within the first three days after birth accounted for 91% of submissions, and 78% of the kits in this age group had no lesions or bacterial isolates. The average weight of kits which died within one day of birth (7.9 g) was significantly lower than the average birthweight of healthy kits (10.7 g). In kits under four days of age and with lesions, the most common diagnoses were dystocia (12%), systemic infection (4%), anasarca (2%), and congenital defects (1%). In unweaned kits four days of age or older, the most common diagnoses were systemic infection (19%), external trauma (6%), dystocia (5%), and cervical adenitis (2%).

Résumé

Mortalité chez les visonneaux, de la naissance au sevrage

Un schéma et les causes principales de mortalité, en 1988, chez des visonneaux, de la naissance au sevrage sont discutés dans la présente étude. Le taux de mortalité présevrage était de 20 %. Des visonneaux soumis pour autopsie, 91 % d'entre eux étaient morts dans les trois premiers jours suivant leur naissance. Soixante-dix-huit pour cent de ces derniers ne présentaient pas de lésions macroscopiques ou d'isolement bactérien positif. Le poids moyen des jeunes morts durant la première journée de vie était plus bas (7,9 g) de façon significative que le poids moyen à la naissance des sujets sains (10,7 g). Parmi le groupe de jeunes âgés de moins de quatre jours, présentant des lésions, les diagnostics les plus fréquents étaient une dystocie (12 %), des infections systémiques (4 %), de l'anasarque (2 %) et des défauts congénitaux (1 %). Chez les jeunes non sevrés de plus de quatre jours, les diagnostics les plus fréquents étaient des infections systémiques (19 %), des traumas externes (6 %), une dystocie (5 %) et une adénite cervicale (2 %).

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Introduction

Small fluctuations in the average number of kits raised per female have a major impact on profit margin for mink farmers, since most costs except feed are fixed, regardless of the average litter size. As the mortality rate in mink kits from birth to weaning is commonly reported to be in the range of 20–30% (1–5), early losses of kits are of major concern to farmers.

There is broad consensus that the majority of these deaths occur within the first few days of life (1–5); however, there is less consensus with regard to the major causes, primarily due to the use of different schemes of disease categorization. There is a tendency to report etiological diagnoses based on subjective and often undefined criteria, making it difficult to determine what lesions were actually observed at necropsy. This may be because few of the reports on the causes of neonatal mortality in mink have been subjected to peer review. The "diagnoses" most commonly made include stillbirth, starvation, hypothermia, hypogalactia, trauma, septicemia, and malformation (3,5,6). The proportion of deaths due to infectious disease is unclear, as systematic or true random culturing of all mortalities, including stillbirths, generally has not been carried out.

The objective of this study was to describe the basic epidemiological pattern of mortality in mink kits from birth to weaning on one farm, and to determine the most common causes of death in this period.

Materials and methods

The study was conducted from April to June, 1988, on a commercial mink farm near Guelph, Ontario. The farm was well managed and free of Aleutian disease, based on regular serological testing of the breeding stock. The breeding herd consisted of 3,082 females, in pastel, dark, sapphire, violet, blush, and brown color phases.

A census of all kits was done within 12 hours of birth, at 10 days of age, and when the animals were pelted in November. The kits were weaned at six weeks of age.

All nest boxes were examined, generally on a daily basis, from birth until weaning. All dead kits were collected, weighed, and had their age recorded. A systematic random sample of the kits under four days of age (every third one; n = 276) and all of the older kits prior to weaning (n = 102) were necropsied. At necropsy, gross lesions were recorded, and samples of liver, spleen, kidney, heart, lung, intestine, and any other organs with gross lesions were fixed in 10% buffered formalin, processed routinely, and stained with hematoxylin and eosin for light microscopic examination. Liver and lung of all necropsied kits under 22 days of age were cultured on blood agar and MacConkey's agar at 37°C for 48 hours, and bacterial isolates were identified by standard methods (7). Tissues from older kits were cultured in the same manner, if this was indicated by the presence of gross lesions.

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Table 1. Most frequent causes of mortality in mink kits from birth to weaning on one ranch in 1988. Estimated total mortality = 3,968 kits (21%), of which 1,580 were submitted for examination

	Proportion of submissions (%)	
Diagnosis	Under 4 days of age[a]	4 days of age or older[b]
No lesions	57	22
No lesions: autolyzed	21	44
Total: No lesions	78	66
Dystocia	12	5
Systemic infection[c]	4	19
Anasarca	2	0
Congenital defect	1	0
External trauma	0	6
Cervical adenitis	0	2
Other	3	2

[a]Based on the necropsy of every third kit submitted (n = 276)
[b]Based on the necropsy of all kits submitted (n = 102)
[c]All cases with moderate to heavy growth from liver and/or lung are included for kits under four days of age (see Table 2); the older age group also includes three cases of peritonitis

The cause of death was categorized on the basis of morphological lesions and bacterial isolates. Questionable cases were classified as "no diagnosis".

Stillbirth was diagnosed if the lungs of animals found dead during the first examination after birth did not float in water. The determination of whether a kit had nursed was based on the presence or absence of milk in the stomach and intestinal tract. All neonates were skinned, and dystocia was diagnosed if subcutaneous hemorrhage was present. Congenital defects and external trauma were recorded if they appeared to have been the cause of death. Systemic infection was diagnosed if there was moderate to heavy growth of the same bacterium from more than one organ. The proportion of deaths due to each cause, using the total number of kits necropsied as the denominator, was calculated separately for kits under four days of age and for kits four days of age and older.

The weight of kits dying within a day of birth was compared to the birthweight of healthy kits, based on litter averages, in a multiple regression model (8). The healthy sample consisted of all litters born on four consecutive days, from pastel, violet, and sapphire color phase females. Litter size and color were included in the regression model, as they were considered to be potential confounding variables. Individual kit weights were recorded in 41 healthy litters of sapphire mink, ranging in size from 4 to 10 kits, and birth weight was regressed on litter size.

Results

A total of 3,968 (21%) of the 18,666 kits born died between birth and the November census. The mortality rate from birth to weaning was calculated by subtracting postweaning losses (n = 178) from the total losses (n = 3,968), resulting in a rate of 20%. Forty percent

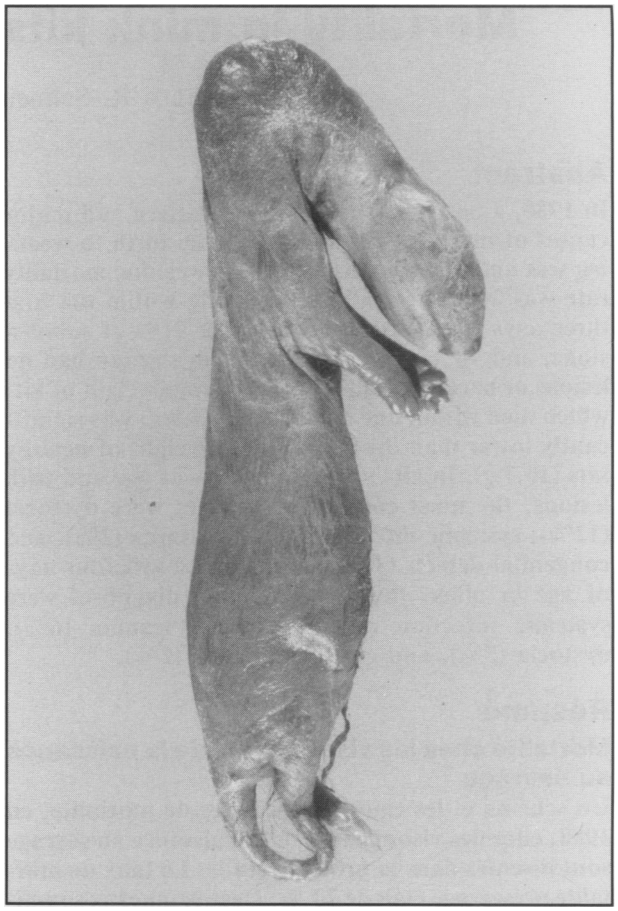

Figure 1a. Gross appearance of a mink kit dying as a result of dystocia, demonstrating the typical ventral flexion of the head.

of the carcasses (n = 1,580) were detected and submitted for examination; presumably, the others were eaten by the dams. Virtually all of the dead kits which were not submitted were under 10 days of age, as deaths after the 10-day census were almost all accounted for.

Mortalities that occurred in the first three days of life accounted for 91% of all kits submitted over the lactation period. After the first week, the number of submissions was fairly constant, at approximately 0.5% of the total submissions per week. Of the mortalities submitted during the lactation period, 53% were stillborn and an additional 35% had not nursed.

The most common finding at necropsy was a complete absence of lesions (Table 1). The histological examination of the kits was hampered by autolysis, resulting from their exposure to high temperatures within the nest, but an absence of lesions was the most common finding in the well-preserved carcasses as well.

In kits under four days of age with lesions, dystocia was the most common diagnosis (12%) as shown in Table 1. In most of these cases, the head had been flexed ventrally against the body, and there was subcutaneous hemorrhage around the head and neck (Figure 1a,b). Systemic infection was diagnosed as the cause of death in 4% of kits under four days of age, based on systematic cultures of liver and lung (Tables

Table 2. Results from the systematic bacteriological culture of liver and lung at necropsy, in kits under 22 days of age

Culture results	Number of kits per category Under 4 days (n = 276)	4 to 21 days (n = 66)
Moderate to heavy growth		
— Liver only	1	0
— Lung only	2	0
— Liver and lung	7	13
Minimal growth (both organs)	16	6
No growth (both organs)	214	27
Not cultured (autolyzed)	39	20

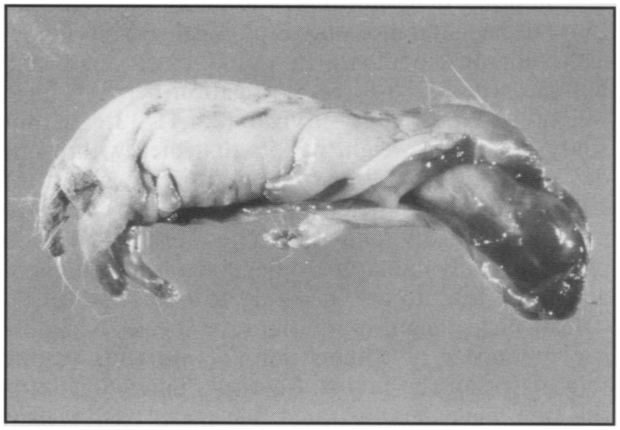

Figure 1b. One-day-old kit with skin partially removed to show extensive cranial and cervical subcutaneous hemorrhage resulting from dystocia.

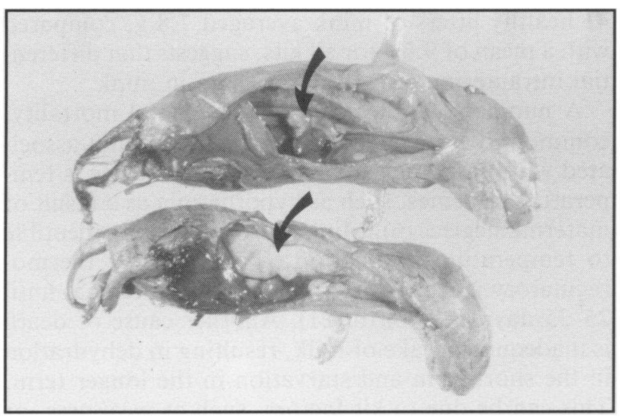

Figure 2. Anasarca in a stillborn mink kit (top), compared with a stillborn kit with no lesions. Note the hypoplastic lungs (arrow) in the anasarcatous kit.

Table 3. Relative frequency of bacterial isolates from the liver and lung cultures performed on kits under 22 days of age. Only cases with moderate to heavy growth in one or both organs are included

Bacterial isolate	Number of isolates	Proportion of cases (%)
Escherichia coli	10	44
Beta *Streptococcus* spp.	6	26
Staphylococcus spp.	4	17
Pasteurella multocida	1	4
Mixture of these pathogens	2	9

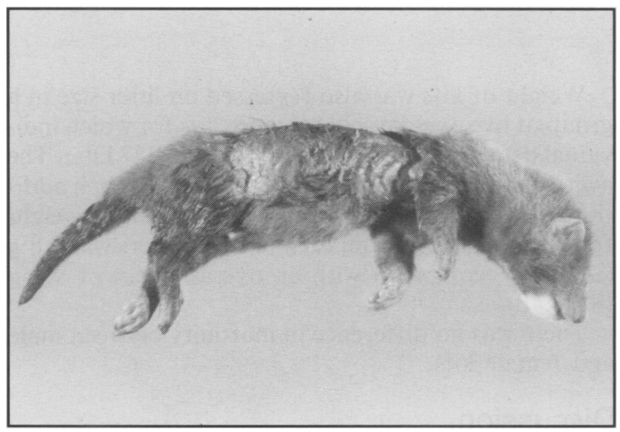

Figure 3. Large region of skin loss over the dorsum as a result of cannibalism in a three-week-old mink kit.

2 and 3). Anasarca and various other congenital defects, such as diaphragmatic herniation and cranial dysplasia, accounted for the majority of the remaining diagnoses in kits in this age group (Table 1). Pulmonary hypoplasia was a consistent finding in the anasarcatous kits (Figure 2).

In older kits (four days to weaning) with lesions, systemic infection was the most frequent diagnosis (19%) as shown in Tables 1 and 2. *Escherichia coli*, beta-hemolytic *Streptococcus* spp. and *Staphylococcus* spp. were the most common isolates (Table 3). Other diagnoses included external trauma, primarily the result of cannibalism (Figure 3), adenitis of the cervical apocrine gland (Figure 4), and internal trauma attributable to dystocia or crushing by the dam (Table 1).

The weight of kits dying within one day of birth (n = 400) was compared to the weight of healthy one-day-old kits (based on litter averages; n = 191), for violet, sapphire, and pastel color phases, in a multiple regression model. In this model, status (live/dead), color, and litter size were significant at $p < 0.001$. The average weight of dead kits was 7.9 g (SE 0.20); live kits weighed 10.7 g (SE 0.13). For each additional kit in the litter, the average kit weight decreased 0.19 g. There was no difference in the mean weight between violet and sapphire kits, but, on average, pastel kits were 0.77 g heavier than those of the other color phases.

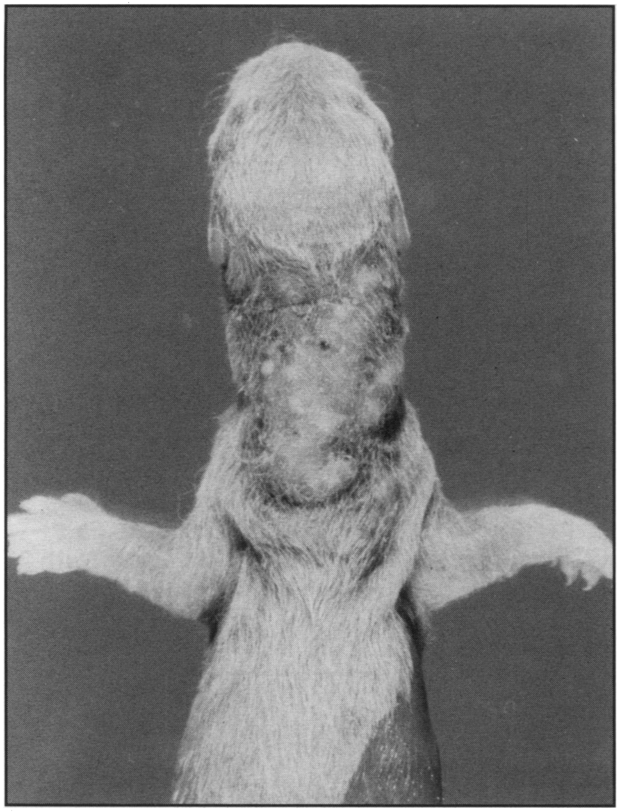

Figure 4. Cervical apocrine adenitis in a five-day-old mink kit.

Weight of kits was also regressed on litter size in a group of live one-day-old sapphire kits for which individual data were available (n = 41 litters; 277 kits). The average effect was a decrease of 0.29 g for each additional kit in the litter ($p < 0.001$). The average weight for the smallest kit from each of these litters was 7.8 g (SE 0.24), compared with an overall mean of 9.6 g (SE 0.10).

There was no difference in mortality between male and female kits.

Discussion

The mortality rate in mink kits from birth to weaning was 20%. This observation is consistent with the results from previous studies in which preweaning mortality rates of 20–30% were reported (1–5). The preweaning mortality rate in cats and pigs is also in the same range (9,10).

Age at death influenced the likelihood that a kit would be eaten before discovery (neonates were selected preferentially) and, therefore, age stratified proportional mortality was used to summarize the findings, instead of using overall cause-specific mortality rates. It was assumed that, within a given age class, the cause of death did not influence the selection of kits that were eaten.

Ninety-one percent of the kits submitted were under four days of age, and we feel that the true proportion of kits that died in this age group was even higher. There were no lesions or significant bacterial isolates in 78% of kits in this group. We believe that these findings accurately reflect the major disease processes that occurred, and that they are common to neonates of all multiparous species.

It is well established that in mink, dogs, cats, and pigs the majority of preweaning mortality occurs in the first few days of life and includes a substantial proportion of stillbirths (2,4,5,10–12). Although mink researchers tend to report various subjective etiological diagnoses, such as "immaturity" or "lack of milk", that obscure the actual necropsy findings, it appears that specific lesions are not observed in the majority of these cases (2,3,5). In cats, dogs, and pigs, it is clearly acknowledged that the majority of neonatal deaths are not associated with pathological changes (10–12).

It appears that, in mink, the major fundamental cause of neonatal mortality is physical and physiological underdevelopment. In mink, cats, dogs, and humans, there is a direct correlation between birth weight and postnatal survival (2,4,11–13). In our study, the mean weight of kits that died within one day of birth was 7.9 g, compared with a weight of 10.7 g in healthy one-day-old kits. It has been proposed that many underdeveloped fetuses are too physiologically immature to begin breathing at birth, and those that do are too weak to nurse (14,15).

Low birth weight in multiparous species is mainly a consequence of competition for nutrients among fetuses within the uterus. Several studies, including this one, have demonstrated that mean birth weight decreases with increasing litter size (16,17). Furthermore, in pigs, rats, and mice, it has been shown that preferential sites for growth exist within the uterus (18–20). The observation that the smallest kits from 41 healthy litters of mink averaged 7.8 g, compared with a mean of 9.6 g for all kits, suggests that differential intrauterine growth also occurs in mink.

A number of other causes of neonatal mortality, common to most multiparous species, are not associated with pathological changes. One of these is temperature extremes, such as hypothermia as a result of maternal neglect (6). Mink kits are highly susceptible to temperature fluctuations, because their thermoregulatory mechanisms are not fully functional until 25–35 days after birth (21). Another cause of death is inadequate intake of milk, resulting in dehydration in the short term and starvation in the longer term. This can be due to kit factors, such as weakness, or dam factors, such as insufficient number of functional teats (22). Genetic constitution appears to have a role in neonatal mortality, as the rates among the various color strains differ (2,23); however, the specific mechanisms are not known. Suffocation and crushing by the dam are also causes of neonatal death. Although all neonates can be affected by these processes, underdeveloped young are most susceptible.

In kits in which lesions were observed at necropsy, systemic infection, trauma (primarily due to dystocia and cannibalism), and congenital malformations were most commonly diagnosed. Infectious disease was of little significance in kits under four days of age, but steadily increased in importance with age. Most infections were due to common opportunistic organisms. In general, this pattern of preweaning mortality appears to be typical for mink and other multiparous species (2,5,10,12,24). In the presence of certain infectious agents, such as Aleutian disease virus, however, infectious disease can be of greater significance than we have indicated here (25).

We conclude that neonatal mortality accounts for a significant proportion of mortality in mink overall, but that these losses are largely a consequence of multiparity. In other words, these are not preventable deaths. Some progress may be expected in minimizing losses through management techniques, such as fostering kits from large litters to small ones, and through genetic selection (26). As the average mortality rate is higher in larger litters (24), the criterion for selecting females as breeding stock should be the number of kits weaned, not the number born.

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