Mesothelioma in cattle: two case reports

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SUMMARY
Introduction - Mesotheliomas are tumours of the mesothelial covering cells of the serous membranes and their supporting connective tissue of mesodermal origin. In domestic animals, little is known about the pathogenesis or the causative factors of malignant mesothelioma. In people, malignant pleural mesothelioma is associated with asbestos exposure. At present, the available data on the prevalence of mesothelioma in cattle are inconsistent.

Aim - This manuscript describes two cases of malignant mesothelioma, one in a cow and one in a young calf.

Materials and methods - A 4-year-old Friesian cow with diarrheal syndrome, marked abdominal distension and partial anorexia and a 37-day-old male mixed breed calf with a history of progressive swelling of the scrotum and abdominal distension were examined.

Result and discussion - Physical examination enabled to include mesothelioma in the differential diagnosis. Ultrasonography and even more histopathology were decisive for the final diagnosis. The animals were euthanized due to poor prognosis.

In both animals, necropsy showed abdominal sero-haemorrhagic effusion and the presence of firm nodules on the peritoneal surfaces, which extended to the thoracic cavity in the cow and to tunica vaginalis in the calf. Based on gross pathology and histopathological findings, the adult cow was diagnosed with acquired malignant mesothelioma, while the calf was diagnosed with predominantly epithelioid congenital malignant mesothelioma.

Conclusion - Interest in mesothelioma has increased since the association between exposure to asbestos fibres and mesotheliomas has been demonstrated in humans. The four-year-old cow object of this report was stabled in a farm with asbestos roofs. The same situation was not observed in the calf. In respect to the latter, the mesothelioma was considered to be congenital in origin. To the best of our knowledge, the calf presented in this report is the first case of bovine congenital mesothelioma involving tunica vaginalis.

KEY WORDS
Cattle, acquired mesothelioma, congenital mesothelioma, asbestos.

INTRODUCTION
Mesotheliomas are tumours of the mesothelial covering cells of the serous membranes and their supporting connective tissue of mesodermal origin. These tumours were reported in cattle, dog, cat, horse, pig\(^2\); so far, they have been considered a rare condition.

The majority of these tumours are to be expected on the peritoneum, the pleura and less frequently on the pericardium\(^2\). Mesotheliomas of the serosa of the male genitalia have been described in humans\(^3\) and dogs\(^5\).

The predominantly epithelioid malignant mesothelioma is the most common type, both in humans and in animals\(^5\). Regarding cattle, epithelioid lesions primarily affect the peritoneum and may secondarily spread to other coelomic cavities. Malignant mesotheliomas are frequently accompanied by cavitary effusion, although cytological examination may not be able to differentiate malignant cells from reactive mesothelial cells\(^5\). Epithelioid mesotheliomas must also be differentiated from metastatic adeno-carcinoma of the lungs, gastrointestinal tract, or uterus\(^6\). Whereas pleural mesothelioma in humans has been proved to be associated to asbestos exposure\(^8\), in domestic animals little is known about the causative factors of malignant mesothelioma. However, some retrospective environmental investigations have shown that also in adult cattle mesotheliosis might be associated to asbestos exposure\(^9\). On the contrary, scientific evidences that asbestos fibres may be related to pleural malignant mesothelioma also in calves are limited\(^1\) and a cause other than congenital origin has not been suggested\(^2\).

In this paper, we describe two cases of mesothelioma: one in an adult cow and one in a young calf, the latter to be potentially considered congenital in origin.

CASE 1

A 4-year-old Friesian pregnant cow was referred due to chronic diarrhoea, marked abdominal distension, partial anorexia, progressive weight loss and rumen hypotonia in the last two months. The cow came from a livestock officially free for tuberculosis, leucosis and brucellosis.
Physical examination showed poor body condition with muscle atrophy and dehydration, but the cow was bright and alert. The abdomen was considerably enlarged and pear-shaped when observed from the rear. The cow often lifted the hind limb trying to hit the flanks. Mucous membranes congestion and jugular veins turgor were also present. Palpable lymph nodes were normal. The cow had a heart rate of 84 beats/min, a respiratory rate of 26 breaths/min and a slightly increased rectal temperature (39.3°C). Pain percussion carried out with the heavy hammer led the animal to kick and sometimes to cough, while withers pinch test was ambiguous. An abdominal fluid wave could be palpated across the ventral portion of the abdomen. Percussion of the abdomen and the thorax revealed a ventral area of dullness suggesting the presence of fluid in the abdominal and thoracic cavities. Trans-rectal palpation revealed the presence of multiple, firm, different size abdominal masses. Abdominal paracentesis showed the presence of a dark red fluid in the peritoneal cavity. Microscopic examination of smears revealed numerous inflammatory cells (lymphocytes, neutrophils, macrophages), and a few active mesothelial cells and intracytoplasmic cocci bacteria. Two conditions were included in the differential diagnosis: peritoneal mesothelioma and septic peritonitis. Transabdominal ultrasonography detected the presence of excessive fluid with varied echogenicity in the abdominal cavity, together with 1- to 10-cm diameter nodular vascularized masses on visceral and peritoneal serous membrane. Fluid presence within the pleural cavity was also con-

![Figure 1](image1.jpg)

**Figure 1** - Adult cow, necropsy. Pleural and peritoneal membranes were studded with firm, pedunculated nodular masses of various sizes. Sometimes, these nodules coalesced to form diffuse plaques. Nodules were also found on serosal surface of many abdominal viscera.

![Figure 2](image2.jpg)

**Figure 2** - Adult cow, histopathology and immunohistochemical examination from a splenic peritoneal nodule. **A)** Histological image: single or multiple layers or discontinuous masses of oval to cuboidal neoplastic cells, with well vascularized connective tissue with variable arborescence. A few spindle cells were also present. Neoplastic cells were arranged in papillae, tubular or acinar-like structures. In some areas, the cells were poorly cohesive, with numerous single cells. Haematoxylin and eosin, 200x. **B)** Immunohistochemical image: diffuse cytoplasmic expression of vimentin. Haematoxylin counterstain, 400x.
firmed. The final tentative diagnosis was therefore peri-
toneal mesothelioma.
Due to the progressive worsening of the clinical conditions,
the cow was euthanized and a complete necropsy was per-
formed. About 35 litres of sero-haemorrhagic fluid were
drained from the abdominal and pleural cavities. The pleu-
ral and peritoneal membranes were studded with firm,
whitish-to-reddish, a few millimetres to 10 cm in diameter,
 sessile, pedunculated or cauliflower-like nodular masses.
Sometimes, these nodules coalesced to form diffuse plaques.
Nodules were found on serosal surface of different abdomi-
nal organs, within thoracic cavity and on the diaphragm, but
did not invade the subjacent parenchyma. Tracheo-bronchial
lymph nodes were markedly increased in volume.
Histopathological examination showed that nodules were
composed of well vascularized connective tissue with vari-
able arborescence, over which there were single or multiple
layers or discontinuous masses of oval to cuboidal neoplastic
cells. A few spindle cells were also present. Neoplastic cells
were arranged in papillae, tubular or acinar-like structures.
In some areas, the cells were poorly cohesive, with numerous
single cells. Many mitotic figures were observed. Neoplastic
cells could be identified in lymph vessels and the tracheo-
bronchial lymph nodes contained subcapsular and in-
termediary metastases. Many of the cells contained PAS-
positive vacuoles.
Immunohistochemistry showed diffuse cytoplasmic expres-
sion of vimentin; some neoplastic cells were positive for
cytokeratin.
Gross pathology, histopathology, histochemistry and im-
munohistochemistry confirmed the diagnosis of malignant
mesothelioma. On the basis of this diagnosis the structures
of the farm were examined and it was found that the roofing
tiles did contain asbestos, some of them being deteriorated.
A potential causative role of an exposure to asbestos fibres
could therefore not be excluded.

CASE 2
A 37-day-old, male, 80 kg, mixed breed calf was referred with
a history of progressive swelling of the scrotum starting
shortly after birth and abdominal distension. The growth
rate was reduced, whereas appetite and stools were normal.
The calf was fed with a milk-based diet.
On physical examination, the calf had slightly decreased
body condition and depressed mental status. The abdomen
was pear-shaped when viewed from the rear. An abdominal
fluid wave could be palpated across the ventral portion of
the abdomen. The scrotum was enlarged, of the dimension
of an arm. On palpation, it was firmer in some areas and
more elastic in others, poorly aching and cold. The scrotum
root seemed tighter and crackling. The cardio-respiratory
examination didn’t reveal any evident pathological find-
ings. Haematological analysis didn’t show any considerable
alteration.
Trans-scrotal ultrasonography was performed and fluid was
observed within the vaginal cavity. A uniformly isoechoic
mass was recognizable, surrounded by several smaller round
and isoechoic structures. Trans-abdominal ultrasonography
detected the presence of excessive fluid in the abdominal cav-
ity, together with an isoechoic mass more than 10 cm wide
that extended from the urinary bladder region to the back-
inxiphoid region. The tentative diagnosis was a congenital neo-
plasia, being the mesothelioma the most probable tumour.
According to the request of the owner an exploratory lap-
aratomy was carried out. The abdominal cavity was filled
with reddish fluid and few fibrin rags; behind the liver a
brick-red, 25-cm-long, mass with a multi-lobed structure
and an irregular surface covered with multiple 1- to 10-mm-
diameter nodular masses took up the left abdominal ventral
side. Due to the extent of the lesions, the animal was eutha-
nized. The necropsy better depicted the condition: the peri-
toneal surface was diffusely covered with many whitish-to-
red, moderately soft, irregular shaped nodules with variable
size protruding from the surfaces. A kidney-shaped mass 25

Figure 3 - Calf, abdominal cavity. A kidney-shaped mass 25 cm in
length was found adjacent to the abomasum. Peritoneal surfaces
were diffusely covered with many irregular shaped nodules. Other
nodules were found on the serosal surface of many abdominal vi-
scosa and on the diaphragm.

Figure 4 - Calf, scrotum. Presence of two structures resembling
degenerate lymph nodes and the same nodular tissue found within
the abdomen, surrounding an apparently normal testis.
In cattle mesothelioma occurs both in adults and, even more, in young calves. The diagnosis was made in a four-year-old cow of our case report revealed that the animal was from a farm with asbestos roofs. Asbestos products are suspected to play an aetiological role in the development of peritoneal mesothelioma also in cattle. Therefore, it has been strongly suggested that cattle should be regarded as valuable sentinels for the identification of human health risk. Supporting this theory, the history of the four-year-old cow of our case report revealed that the animal was from a farm with asbestos roofs. In cattle, mesothelioma occurs both in adults and, even more frequently, in calves. In our first case, mesothelioma was diagnosed in a four-year-old cow, suggesting an acquired mesothelioma. Conversely, in the second case, the young calf could be considered affected by a congenital form. In the case of acquired mesothelioma presented here, nodules were predominantly located on the parietal peritoneum, the omentum, the spleen and the stomach. In human and swine, mesotheliomas usually develop in the pleural cavity. In our case, pleural involvement was found as discrete nodules on the cranio-ventral lobes. Pericardium was also involved. It has been reported that the pleural involvement may develop as a result of spread from the peritoneum via the diaphragm.

DISCUSSION AND CONCLUSION

Interest in mesothelioma has increased since the association between exposure to asbestos fibres and mesotheliomas in humans was demonstrated. Initially, mesothelioma risk was confined primarily to occupational groups using asbestos products. Today, it is clear that non-occupational hazard exists, such as household and building-occupant exposures. Products containing asbestos fibres are suspected to play an aetiological role in the development of peritoneal mesothelioma also in cattle. Therefore, it has been strongly suggested that cattle should be regarded as valuable sentinel species for the identification of human health risk. Supporting this theory, the history of the four-year-old cow of our case report revealed that the animal was from a farm with asbestos roofs. In cattle, mesothelioma occurs both in adults and, even more frequently, in calves. In our first case, mesothelioma was diagnosed in a four-year-old cow, suggesting an acquired mesothelioma. Conversely, in the second case, the young calf could be considered affected by a congenital form. In the case of acquired mesothelioma presented here, nodules were predominantly located on the parietal peritoneum, the omentum, the spleen and the stomach. In human and swine, mesotheliomas usually develop in the pleural cavity. In our case, pleural involvement was found as discrete nodules on the cranio-ventral lobes. Pericardium was also involved. It has been reported that the pleural involvement may develop as a result of spread from the peritoneum via the diaphragm.

Scrotal mesothelioma has been described in other studies but, to the best of our knowledge, this is the first case of bovine congenital mesothelioma involving tunica vaginalis. Clinical signs of mesothelioma may vary. According to the current literature, reference to clinical signs are scant and diagnosis is often made during gross examination of food-producing animals at the slaughterhouse. Mesotheliomas can be difficult to be differentiated from inflammatory proliferation of mesothelial cells, metastatic pleural adenocarcinoma, and peritoneal spread of papillary serous cystadenocarcinoma of ovarian origin. Mesotheliomas also show clinical similarity to peritoneal tuberculosis ("pearl disease") and in some instances, can mimic peritoneal metastasis of some other primary tumours. It is therefore possible that the dearth of mesothelioma diagnosis in the past may be due to identification problems during post-mortem examination, together with the paucity of symptoms in the living animal. On the other hand, the short productive life of farm animals, especially beef cattle, and the scarce interest and/or economic benefit in carrying out all the examinations needed to reach a diagnosis and possibly treat a diseased farm animal instead of culling it are likely to contribute to the reported low prevalence of this slow-developing and often silent neoplasia.

References