Intestinal and peritoneal lesions in pigs with wounded umbilical outpouchings transported to the abattoir

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Abstract

Background

Umbilical outpouchings (UOs) in pigs are of welfare and production concern in Danish pig herds. One of the challenges is the transportation of these animals due to the size of the UOs and ulcerations on them. With certain precautions and an approval from a veterinarian, pigs with UOs may be transported, however, UOs are associated with several intra-abdominal lesions, e.g. peritonitis and incarceration, which may worsen during the process of transportation. The prevalence and characterization of intra-abdominal lesions associated with UOs following transportation has not been investigated. Therefore, the objective of the present study was to evaluate lesions associated with the intestines and peritoneum in slaughter pigs with wounded UOs following transportation to an abattoir.

Results

A cross-sectional study involving three conventional Danish pig herds was conducted comprising 96 slaughter pig with wounded UOs transported to an abattoir. Following slaughter the UOs with accompanying intestines were examined pathologically. Three distinct morphological categories were present; hernia, enterocystoma and herniating enterocystoma. Intra-abdominal lesions were present in 72% of the animals, representing 65% (44/68) of the hemias, 77% (10/13) of the enterocystomas, and 100% (15/15) of the herniating enterocystomas. Several different lesions were found like bleedings, acute/chronic peritonitis and hypertrophy of the intestinal muscular layers.

Conclusions

The prevalence of intra-abdominal lesions in pigs transported with a wounded UO was found to be high independent of the underlying condition, and it is clear that these pigs possess a vulnerable group of animals, especially during physical stressful situations like transportation. More information is needed regarding the prevalence of intra-abdominal lesions in UO pigs without wounds on the UO. The results provide valuable knowledge, that can be used when examining and evaluating UO pigs before transportation.

Background

In Danish conventional pig herds the prevalence of umbilical outpouchings (UOs) is 4.2% (1), and with about 32 million piglets produced annually in Denmark, this equates to approximately 1.4 million pigs with an UO (2,3). It has been estimated that 1.3% of pigs have an UO at the time of slaughter (4). Various factors may be responsible for this decrease in prevalence. However, the main cause is likely unfitness for transportation, death or euthanasia, due to complications relating to the UOs. In addition, both the size and the presence of ulcerations on the surface of the UOs, play an important role, since both factors affect the eligibility for transport according to the Danish legislation. (3)

In Denmark, pigs are by the Animal Welfare Act § 2 (5) protected against pain, suffering, anxiety, lasting harm, and significant inconvenience. Moreover, in the European and Danish transport order (6), it is directed that slightly injured or sick animals can be transported when certain precautions are taken (extra space and soft bedding) and the animal has been deemed eligible for transportation by a veterinary clinician. However, it may be difficult to approve pigs with UOs to be fit for transportation due to the various underlying causes of UOs in pigs. Even though a pig with an UO seems eligible for transportation from the clinical examination, the impact of transportation may be stressful and can lead to worsening health and death of the animal, as several pathological complications may derive from having an UO, e.g. peritonitis, intestinal incarceration, and hemorrhages (7, 8). Therefore, it is most likely that such intra-abdominal lesions may be exacerbated by the physical impact before, during, and after transportation to the slaughterhouse, potentially resulting in increased suffering and distress. However, the prevalence of UO-associated pathology following transportation has not been investigated. Therefore, the objective of the present study was to evaluate lesions associated with the intestines and peritoneum in slaughter pigs with wounded UOs following transportation to an abattoir.

Results

Of the 96 UOs, 68 as umbilical hemias, 13 were categorized as enterocystomas, and 15 as herniating enterocystomas. Intra-abdominal lesions were observed in 72% (69/96) of all cases (in 65% (44/68) of hemias, 77% (10/13) of enterocystomas, and 100% (15/15) of the herniating enterocystomas). Lesions were classified as either bleedings (hemorrhage, hematomas, and hemosiderosis), inflammation (acute and chronic peritonitis), adherences, ruptures, and/or hypertrophy of the intestinal musculature (Table 1). Hemorrhages were the most frequent finding in all three categories, ranging from a few petechial bleedings to multifocal/coalescing ecchymosis, which were most often appearing in the peritoneal lining of the outpouchings and in the serosal lining and the mesentery of the jejunum (Figs. 1 and 2). Hematomas were only present within the cavity of the UOs (Fig. 3), and hemosiderosis (Fig. 4) was seen as focal areas of black discoloration of the serosa and were mainly situated on the jejunal segment in relation to other lesions. Chronic peritonitis was also a frequent observation in pigs of all three categories (18% (12/68) in umbilical hernia, 31% (4/13) in enterocystomas, and 73% (11/15) in herniating enterocystomas). Lesions associated with chronic peritonitis were ranging from small foci of peritoneal fibrous thickening to extensive involvement of several intestinal segments with widespread fibrosis, roughening of the serosal surface and fibrous adhesions (41% of chronic peritonitis cases) (Figs. 5 and 6), both between intestinal segments and to the parietal peritoneum. Segmental hypertrophy of the intestinal muscular layers was present in 16 cases. This was solely present in parts of the small intestine (Fig. 7), and it was seen in nearly half (47% (7/15)) of the cases.
with a herniating enterocystoma, while it was less frequently present in cases of enterocystomas (15% (2/13)) and umbilical hemias (10% (7/68)). Acute lesions, in the forms of acute rupture (intestinal or peritoneal) and/or acute peritonitis (Figs. 8 and 9) were registered in 13 pigs and were only observed in cases with umbilical hemias and herniating enterocystomas. Here it showed a frequency of 15% (10/68) and 20% (3/15), respectively. In a single case of peritoneal rupture of an umbilical hemia, the rupture extended through to the surface of the skin, causing a complete perforation of the UO.

In a majority of the intestinal samples, histopathology revealed hemorrhage in one or multiple layers of the intestinal wall and in the mesentery (Fig. 10). Fibrin exudation to the serosal surface of the intestines was found in cases associated with inflammation. The presence of acute peritonitis was confirmed by the occurrence of hemorrhage, in combination with fibrin exudation and leukocyte infiltration on the intestinal serosa and mesentery (Fig. 11). When chronic peritonitis was present, a thickening of the intestinal serosa and/or mesentery was observed with formation of fibrosis and/or granulation tissue (Fig. 12). In intestinal ruptures, hemorrhage and neutrophilic inflammation was observed at the edges of the perforation extending into the intestinal wall, and intestinal contents were observed on the surface of the intestines (Fig. 13). Intestinal muscular hypertrophy was in all cases present as a segmental thickening of the circular layer of tunica muscularis externa (Fig. 12).

Discussion

The majority of pigs with UOs showed intra-abdominal lesions (72%), regardless of the appointed category. In a study by Schild et al., behavioral changes in pigs with UOs at a pick-up facility were observed (9). These included increased sitting time and decreased latency to lie down, especially in pigs with umbilical hemias. These behavioral changes are indicative of an increased discomfort, hence suggesting pigs with UOs to be less fit for mixing during transportation. The pigs in the present study were on the day of transportation all deemed eligible for transportation. However, the occurrence of intra-abdominal lesions in transported pigs with UOs has hitherto not been elucidated.

Acute lesions, i.e. acute peritonitis and/or rupture, were found in 13 pigs and observed in two out of the three categories with 15% of the hernias and 20% of the herniating enterocystomas. These acute lesions have a short timeline, and they are compatible with having developed within a few hours before slaughter. This could indicate that some animals may have an increased risk of injury during the process of transport. In this study no acute lesions were found in pigs with enterocystomas. However, due to the low number of pigs with acute lesions more research in needed to investigate whether the presence of a hernial opening is a risk factors for UO pigs to develop acute lesions.

A high number of chronic lesions, e.g. chronic peritonitis and adhesions was found in all categories of UO-animals. Studies of intra-abdominal adhesions in humans post-surgery have shown that patients consider adhesions as a painful affliction (10, 11), which is likely also to apply for pigs. Therefore, movement, strain and physical impacts associated with transportation, therefore, may cause amplification of the pain and discomfort for the animals.

The pigs in the present study all had wounds on the UOs. However, it is likely that animals without wounds on the UOs would present with similar types and frequencies of lesions, following the transportation-process including the physical stressors from staying in a pick-up facility, loading and unloading, and the drive at the abattoir. However, to extrapolate the findings in this study to UO pigs in general more knowledge is needed regarding the prevalence and severity of intra-abdominal lesions in UO pigs without wounds.

The transportation time for the included animals did not exceed 2 hours, which also complied with the Danish transport regulations stating that pigs with UOs that are approved for transport, must be directly transported to an abattoir in close proximity to the farm of origin. However, the regulation does not specify a maximum transportation time. Longer transportation time than in the present study, is therefore also likely to increase the risk of developing or exacerbating UO-associated lesions in pigs.

Conclusions

Based on the present study, the prevalence of intra-abdominal lesions in pigs transported with a wounded UO was found to be high independent of the underlying condition, and it is clear that these pigs possess a vulnerable group of animals, especially during physical stressful situations like the process of transportation. The results provide valuable knowledge, that can be used when examining and evaluating UO pigs before transport, so especially acute lesions associated with the process of transportation can be reduced.

Methods

This study was designed as a cross-sectional study of finisher pigs transported to slaughter with wounds on the UOs. The data were collected from three Danish conventional swine herds from January to June 2023.

A total of 96 Danish crossbreds (Landrace/Yorkshire x Duroc) were included. Before pigs were included, a thorough clinical examination by a veterinarian was carried out the day before transportation and slaughter. The assessment of fitness for transport under special circumstances included that the animals should be in general good condition and the UO should not be distended, warm, or associated with pain at palpation. The wound on the UO had to be dry and less than 4 cm in diameter. Transportation time to the abattoir had a maximum of 2 hours.

On the transportation lorry, the pigs with UOs were placed in groups of 5 to 7, which were separated from other pigs, and they had extra room and bedding in accordance with guidelines provided by The Danish Veterinary Health Council, 2008 (12). At the abattoir, standard slaughter procedures were
carried out, and the UOs together with the gastrointestinal tract were transported to pathologic examination, which was performed within 6 hours after slaughter.

When arriving at the University of Copenhagen for pathologic examination, the UOs together with the gastrointestinal tract, were registered by the ear tag number and given an individual journal number. The UOs were standardly photographed, with an overview of the dorsal and ventral surfaces. In addition, an overview photo was taken of the intestines, and the content of the UOs.

The dimensions (length, width, height, depth) of the UOs were recorded. The UOs were categorized as either 1) an umbilical hernia, a sac formed by a pouch of parietal peritoneum protruding outside the abdominal cavity, 2) an enterocystoma, a cystic congenital malformations due to a non-regression of the yolk-sac, or 3) a herniating enterocystoma, a combination of the two, comprising a multi-cystic structure and a hernial ring (13, 14) A thorough pathological examination was carried out on the intestines and the peritoneal lining of the UOs (see Table 1). During necropsy, tissue samples were collected from the different lesions for histological examination. Tissue samples were fixed in 10% neutral buffered formalin, and processed routinely for histopathology and stained by hematoxylin and eosin.

Declarations

Acknowledgements
Thanks to participating herds and students assisting with data collection.

Author contributions
Study design: BMJ, TBJ, AB, HEJ. Recruiting herds, data and sample collection in herds: TBJ, AB. Pathological examination: BMJ, CBB, CKF, MVC, HEJ. Statistical analysis: BMJ, CBB, HEJ. Writing first manuscript draft: BMJ. Project administration: TBJ, HEJ. All authors read and approved the final manuscript.

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Ethics approval and consent to participate
Not applicable.

Animal ethics approval
Transportation of animals was approved by the The Animal Experiments Inspectorate of Denmark.

Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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Table 1

Table 1. Intra-abdominal lesions associated with causes of umbilical outpouchings.
<table>
<thead>
<tr>
<th>Lesions</th>
<th>Umbilical hernia N=68</th>
<th>Enterocystoma N=13</th>
<th>Hemiating enterocystoma N=15</th>
<th>Total</th>
</tr>
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<tr>
<td></td>
<td>Mean dimensions: 15,55x13,71 (±2,97x2,62)</td>
<td>Mean dimensions: 14,38x12,92(±4,02x4,48)</td>
<td>Mean dimensions: 17,23x14,37 (±3,52x2,61)</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
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</tr>
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<tr>
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Intestinal muscular hypertrophy:

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</table>

Figures

Figure 1

Widespread hemorrhages in the jejunal mesentery.
Figure 2

Widespread hemorrhages in the peritoneal lining of an umbilical hernia.
Figure 3

More hematomas (arrows) are present in the hernial cavity.

Figure 4

The serosal lining of the jejunum (arrow) is discolored due to hemosiderosis.
Figure 5

In the mesentery and around a part of jejunum (encircled) chronic peritonitis is present.
Figure 6

Chronic, fibrous, adhesive peritonitis between the serosal lining of the hernia cavity and adherent intestines (arrows).

Figure 7

Segmental muscular hypertrophy of jejunum (arrow).
Figure 8

Acute rupture of jejunum accompanied by hemorrhage and exudation of fibrin (arrow).
Figure 9

Area of acute, fibrinous peritonitis in the serosal lining of the jejunal mesentery.

Figure 10

Histologically, acute hemorrhages is present in the mesentery of jejunum.
Histologically, acute hemorrhagic peritonitis with influx of neutrophils is present in the mesentery of jejunum.
Figure 12

Histologically, the serosal lining of jejunum is covered by fibrotic/ granulation tissue (chronic peritonitis (CP)) together with hypertrophy of tunica muscularis externa (HM).

Figure 13

Histologically, within and around an acute intestinal rupture hemorrhage, exudation of fibrin and influx of neutrophils are accompanied by the presence of intestinal contents on the serosal lining (arrow).