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Manifestation of proliferative enteropathy of pigs (ileitis) in pig farms of Ukraine (diagnostic monitoring)

I. Yu. Mushtuk, O. Y. Ayshpur, O. M. Yermolenko, O. A. Tarasov, V. V. Gumeniuk
mushtuk0104@gmail.com, olenaayshpur@gmail.com, alex-dndi@ukr.net

The Institute of Veterinary Medicine NAAS,
30 Donetska str., Kyiv, 03151, Ukraine

Proliferative enteropathy of pigs (PPE; ileitis, lawsoniosis) is one of the most common, relatively new and little-studied gastrointestinal diseases of pigs which cause significant economic damage to the pig industry worldwide. The causative agent of ileitis is *Lawsonia intracellularis*, a gram-negative intracellular bacterium. The incubation period lasts from two to three weeks, the infection has a high degree of infection. The pathogen is transmitted from animal to animal by oral and fecal route. In order to study the manifestations of proliferative enteropathy of pigs on farms in Ukraine, we surveyed 32 farms in 13 regions. The course of PPE was usually observed with symptoms of gastrointestinal disorders, but the disease brought significant economic losses. A characteristic symptom of the chronic course in the studied farms of Ukraine is a slow but progressive weight loss of animals and, as a result, diarrhea and loss of appetite. Clinical signs of ileitis depend on the form of the course. There are three main forms of ileitis: chronic form — intestinal adematosis, acute — hemorrhagic enteropathy and subclinical form. According to our research, the acute form is manifested by pale skin and signs of anemia, hemorrhagic diarrhea and sudden death of the animal. Pigs weighing more than 70 kg suffer the most. The pathological picture characteristic of PPE was observed already at the age of 33 days; 62.5% of the dead piglets aged 33 to 102 days were affected by *Lawsonia*, which was confirmed by laboratory tests. Pathological examination was observed in the dead pigs of the rearing and fattening group: duodenum — part initially covered with mucus-fibrin; ileum — thickening of the walls, on the serous membrane dark red grooves like a mosaic, dark blood, blood coagulates cylindrical forms; mucous membrane is uneven, thickened, intensely red; colon — stretched through gases, blood dark with coagulates in the lumen; rectum — the contents are thick to semi-liquid, dark red; mesenteric lymph nodes — enlarged and hyperemic. Pathohistological changes in the intestine varied. In some parts of the intestine, there were characteristic of ulcerative necrotic ileitis, and in others — for proliferative enteropathy.

Key words: proliferative enteropathy (ileitis), diarrhea, pigs, *Lawsonia intracellularis*

Porcine proliferative enteropathy (PPE; ileitis, lawsoniosis) is one of the most common, relatively new and poorly studied gastrointestinal disease of pigs, causing significant economic losses of the pig industry worldwide [1].

The main causative agent of ileitis is *Lawsonia intracellularis* — a gram-negative intracellular bacterium. It penetrates the intestinal mucosa of the terminal part of aileum intestine and causes excessive reproduction of enterocytes. As a result, there is a thickening of the intestine and a decrease in resorption processes appears, which leads to a disorder of the gastrointestinal tract [3–5, 7].

The incubation period is considered to be between two and three weeks. The pathogen is transmitted from animal to animal by oral and faecal transmission. The piglets that are still drinking the milk can become infected after having a contact with the sow's faeces. PPE is transmitted through the birds, rodents, various equipment for animal's care, transport.

There are clinical forms of of ileitis: chronical form which is an intestinal adematosis, incisive which is a haemorrhagic enteropathy and subclinical form (table 1).

Lawsonia can occur worldwide, especially in the countries and regions where pigs are intensively farmed. It does not matter whether there is intensive or extensive form of farming, and what are the differences in technological processes and capacities [2, 6, 8, 9].

Table 1. Pathological changes in PPE depending on the location of the lesions

Pathological diagnosis	Pathological changes
Porcine intestinal adenomatosis (PIA)	Abnormal proliferation of cells of the intestine submucosal layer
Necrotic enteritis (NE)	The destruction of cells after proliferation, the intestinal wall becomes thin
Regional ileitis (RI)	Inflammation of the terminal part of the small intestine
Porcine hemorhagic enteropathy (PHE)	Bleeding in the small intestine

The economical losses of ileitis in subclinical and clinical forms are very significant and depend on the age and number of infected animals and the level of morbidity.

Recent analysis confirmed that from 30% to 100% of farms have been infected with the *Lawsonia intracellularis*. For the farms the morbidity varies from 12% to 26.5%. According to the other sources, the infection level can even reach 30–70% of pig population. The lethality among affected pigs is higher than 40%. The spreading of the disease and high level of transmission lies upon the risks of endemic spreading [10, 12].

This paper presents the results of the studies of proliferative enteropathy spreading in pigs in Ukrainian farms, the first cases of which are described here in 2008–2009.

According to our research, 653 blood serum samples of pigs of different age groups from 17 domestic farms with a population of 40,456 sows revealed 46.4% of seropositive animals. Seropositive pigs were found in all analysed farms, namely 74.0% among sows, 79.6% among repair pigs, 2.5% among piglets for rearing and 59.8% among pigs for fattening. The epizootic situation in the country requires detailed assessment and in-depth analysis [11].

The aim of our work was to study the manifestation of proliferative enteropathy of pigs (ileitis) on farms in Ukraine.

Materials and Methods

The research was conducted in the laboratory of bacterial diseases of animals in the Institute of Veterinary Medicine NAAS and in some pig farms in Ukraine. During the research studies, 32 farms of 13 districts were surveyed. The research was conducted on pig farms of different capacity using different technologies of pig breeding. Pathohistological examinations were performed in three basic farms with a full cycle of degeneration of pigs in Donetsk (population of 90 thousand pigs), Cherkasy (population of 20 thousand pigs), and Kirovohrad regions (population of 60 thousand pigs). These farms grow pigs of the following breeds: Large White, Landrace, Duroc and local breeding.

The diagnosis on proliferative enteropathy was established comprehensively on the basis of epizootological, clinical, pathological and laboratory tests. The biological samples were obtained from slaughtered pigs of different age groups (from the age of 21 days till the end of fattening) with the characteristic signs of ileitis.

Clinical studies of pigs were conducted according to generally accepted methods in the practice of veterinary medicine, taking into account the technology of pig breeding, feeding conditions, the state of implementation of sanitary and hygienic rules for keeping animals, which are the risk factors of the appearance and development of a disease.

The necropsy of dead pigs was performed by the method of post-mortem examination. Samples for histological/histopathological tests were taken from the ileocecal foramen (first sample), in 5 cm from the base (beginning) of the cecum (second sample) and in 10 cm from the upper proximal part of the colon (third sample). The samples for histological examination were carefully placed in a 10% buffered formaldehyde solution preserving sensitive surface of the mucosa. All the samples were marked for further identification. The samples were poured into paraffin. The sections 4–5 μm thick were sliced and stained with hematoxylin and eosin die according to the classic protocol.

Results and Discussion

Epidemiological monitoring, clinical and pathological studies on the proliferative enteropathy (PPE) among pig population in Ukrainian farms were conducted (fig. 1).

The course of PPE was usually observed without any specific symptoms, but the disease inflicts significant economic losses. One of the typical signs of the chronic course in the observed farms of Ukraine was

Fig. 1. Regions of Ukraine covered by monitoring studies for proliferative enteropathy of pigs

a progressive decrease of body weight in animals because of the diarrhoea and refusal of feed. In some cases, the disease was accompanied by fever, abortion of sows or sudden death. Such different symptoms were observed in each study pig farms where ileitis was diagnosed.

The animals with the signs of anorexia, marble mucous membranes, dark blood around the anus died within 6 hours after manifestations of diarrhoea symptoms (fig. 2–3).

Necropsy revealed the symptoms in the pigs of the rearing and fattening group: the initial part of the thin intestine was covered with mucus-fibrin plaques; ileum had the thickening of the intestinal walls, local haemorrhagic spots on the serous membrane. Coagulated blood had the cylindrical form of clots; mucous membrane was uneven, thickened, intensely red staining. The colon was stretched, dark red with coagulated blood traces in the lumen. The rectum content was from a thick to a semi-liquid with a dark red colour. The mesenteric lymph nodes were enlarged and hyperaemic (fig. 4–5).

The pathological signs were typical for PPE and were detected in pigs at the age of 33 days; 62.5% of the dead piglets infected by *Lawsonia* were between 33 to 102 days old, which was confirmed by laboratory tests. The affected intestines were taken from 44 dead piglets of the rearing (n=24) and fattening groups (n=20), 63.6% had ileitis signs and 36.4% had intestinal haemorrhagic lesions.

The pathohistological changes of intestine varied by the severity of disease. In some sections of the intestine they were typical for ulcerative necrotic ileitis or for proliferative enteropathy.

The pathohistological studies of the thick intestine revealed the enterocytes desquamation in the cilia apical parts, the enterocytes proliferation near the basement membrane and the number of goblet cells was decreased. Thickening of the intestinal wall occurs due to the proliferate cells accumulation in a mucous membrane as well as the intense lymphoid cells infiltration. These processes accompanied by the hypoxia: vessels are empty containing only single erythrocytes. The reduced activity of intestinal lymph follicles was detected, and their centres were enlightened and empty (fig. 6).

The germinal layer the crypts contained a large number of goblet cells as well as the malformation of the retention cysts.

The pathomorphological changes were found in the intestines of piglets infected with *Lawsonia intracellularis*: villous and almost absent of a coagulation necrosis, decrease of villous size; the inflammation process was localised in the form of infiltration mainly with histiocytes and in less numbers of leukocytes, eosinophils, neutrophils. The crypts were compressed by the cells due to enterocytes proliferation. A significant reduction in goblet-like cells or their absence was detected. Smooth muscle cells were hypertrophied, swollen, inflamed. Peyer's patches in the crypt, manifestation

Fig. 2. Uneven livestock due to ileitis

Fig. 3. Pig's diarrhea: from liquid to watery feces (chronic form of ileitis)

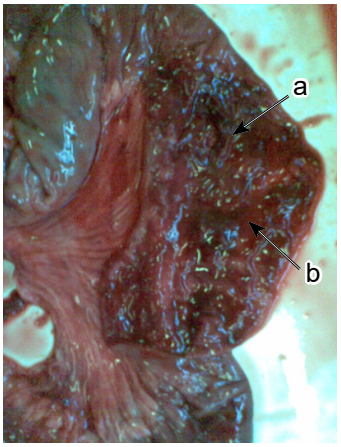

Fig. 4. Ileum. Thickened walls, dark red color, blood coagulation (a); the mucous membrane is uneven, thickened, hyperemic (b). Pig's age is 125 days

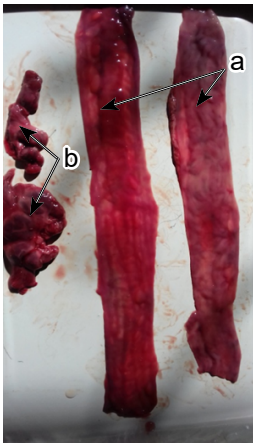

Fig. 5. The pig's ileum is thickened due to proliferative enteropathy caused by *Lawsonia intracellularis* (a). Mesenteric lymph nodes are enlarged and hyperemic (b). Pig's age is 75 days

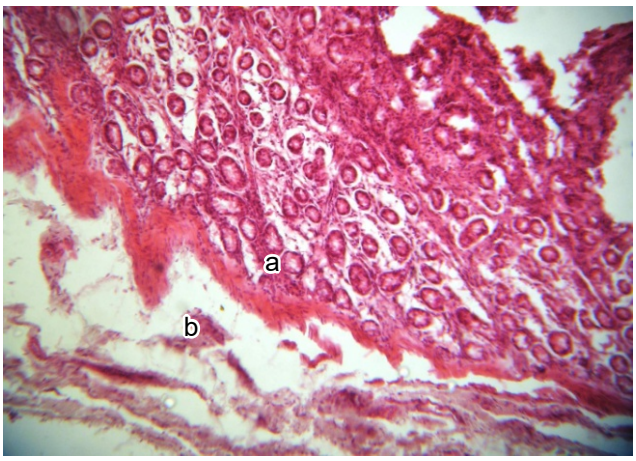

Fig. 6. Fragment of the colon wall near the ileocecal opening in 145-day-old piglets.
a — intestinal wall;
b — transudation of the submucosal layer of the intestine

of necrosis, haemorrhage, granulosa infiltrate, other intestine lesions including haemorrhagic necrosis, swelling of mucosal and submucosal layer were detected during our studies.

Histological tests are important diagnosing approach for detecting heavy pathological changes in the intestinal system of infected pigs.

According to foreign researchers, the disease is widespread in all countries of the world, where the pig industry is developed. Proliferative enteropathy (ileitis) in pigs is one of the most common diseases of the digestive tract which affects piglets of older rearing and fattening groups. It is associated with significant economic losses which are expressed in the animals' mortality, reduced growth rates, the impact on feed conversion, the cost of control measures.

Prevention of infectious gastrointestinal diseases, including ileitis, in pigs is of great importance. In order to prevent ileitis, along with specific prevention and therapy, there should also be organizational, economic, technological, veterinary, zootechnical and other measures aimed at increasing the overall resistance of animals. Also, the maximum reduction in the concentration of microorganisms — pathogens in the premises.

Common risk factors for proliferative enteropathy in pigs are constant filling of the pigsty without sanitary breaks, poor hygiene, unperforated floors in the premises. Stress (transportation, high housing density, herd regrouping, etc.) further reduces the immunity of animals. Insufficiently satisfactory conditions in the premises (cold, drafts), poor quality feed or a sharp change in their composition are also risk factors.

Suitable chemotherapeutics for the prevention and treatment of PPE are tiamulin, tetracyclines and macrolides. Resistance to *Lawsonia intracellularis* is an exceptional phenomenon due to the inability to transmit resistance by non-chromosomal means. A live vaccine is used to prevent *Lawsonia intracellularis*-induced gastrointestinal upset syndrome in pigs.

Conclusion

1. Conducted diagnostic monitoring of proliferative enteropathy of pigs on farms in Ukraine and proved the significant spread of the disease, which causes significant damage to the domestic pig industry.

2. Pathological examinations of dead piglets revealed that suckling piglets have no signs of ileitis, the pathological picture characteristic of PPE is observed at 33 days of age; 62.5% of the dead piglets aged 33 to 102 days were affected by *Lawsonia*.

3. The results of histopathological studies indicate that the causative agent of ileitis *Lawsonia intracellularis* causes profound pathological changes in the digestive tract of pigs, which affects the functioning of all organs and tissues of animals, which lead to severe disease and death of animals.

Prospects of Further Research

The choice of research work is due to insufficient study of the disease and presents the results of research, including epizootological monitoring, clinical signs, pathomorphological changes, diagnosis, development of measures to prevent and control PPE in pig farms in Ukraine. The domestic pig industry suffers from diseases of infectious etiology. PPE also belongs to economically significant diseases. Therefore, the study of the epizoo tic state of PPE in pig farms in Ukraine, methods of its diagnosis are relevant and promising for solving problems of prevention and control of the disease.

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Прояви проліферативної ентеропатії свиней (ілеїту) у свиногосподарствах України (діагностичний моніторинг)

І. Ю. Муштук, О. Є. Айшпур, О. М. Єрмоленко, О. А. Тарасов, В. В. Гуменюк
mushtuk0104@gmail.com, olenaayshpur@gmail.com, alex-dndi@ukr.net

Інститут ветеринарної медицини НААН,
вул. Донецька, 30, м. Київ, 03151, Україна

Проліферативна ентеропатія свиней (ПЕС; ілеїт, лавсоніоз) є однією із найпоширеніших, відносно нових та маловивчених шлунково-кишкових хвороб свиней, які завдають значних економічних збитків галузі свинарства у всьому світі. Збудник ілеїту — *Lawsonia intracellularis* — грамнегативна внутрішньоклітинна бактерія. Інкубаційний період становить від двох до трьох тижнів, інфекція має високий ступінь зараження. Збудник передається від тварини до тварини орально-фекальним шляхом. З метою вивчення проявів проліферативної ентеропатії свиней на фермах України було обстежено 32 господарства 13-ти областей. Перебіг ПЕС зазвичай мав симптоми розладу шлунково-кишкового тракту, проте хвороба завдавала значних економічних збитків. Характерний симптом хронічного перебігу в досліджуваних господарствах України — повільне, але прогресивне зменшення маси тіла тварин як результат діареї і зниження апетиту. Клінічні ознаки ілеїту залежать від форми перебігу. Розрізняють основні три форми перебігу ілеїту: хронічна форма — кишковий адематоз; гостра — геморагічна ентеропатія; субклінічна форма. Згідно з нашими дослідженнями, прояви гострої форми — блідість шкіри та ознаки анемії, геморагічна діарея та раптова смерть тварини. Найбільше потерпають свині масою тіла понад 70 кг. Патологоанатомічну картину, характерну для ПЕС, спостерігали вже у 33-денному віці; 62,5% у патрозтині загиблих поросят віком від 33 до 102 днів уражені лавсонією, що було підтверджено лабораторними дослідженнями. За патологоанатомічного дослідження у загиблих свиней групи дорощування та відгодівлі спостерігали: дванадцятипала кишка — частина на початку вкрита слизо-фібрином; клубова кишка — потовщення стінок, на серозній оболонці темно-червоні борозенки у формі мозаїки, кров темна, кров'яні коагуляти циліндричної форми, слизова оболонка нерівна, потовщена, інтенсивно червона; ободова кишка — розтягнута через гази, кров темна з коагулятами в просвіті; пряма кишка — вміст густий до напіврідкого, темно-червоний. Мезентеріальні лімфовузли збільшені та гіперемовані. Патологогістологічні зміни у кишечнику були різноманітними. В одних ділянках кишечнику вони були характерними для виразково-некротичного ілеїту, а в інших — для проліферативної ентеропатії.

Ключові слова: проліферативна ентеропатія (ілеїт), діарея, свині, *Lawsonia intracellularis*

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