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Epidemiological Peculiarities and Economic Efficiency of Veterinary Measures in Case of Diplococcal Infection of Pigs

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ABSTRACT

The article presents epizootological and clinicomorphological data on the course of diplococcus septicus infection of piglets in private pig-growing farms of Kotayk Region, Republic of Armenia. According to the results of the studies, the main reasons for the appearance of the mentioned infection among piglets is the failure in observing zoohygienic and veterinary-sanitary rules throughout housing of animals, as well as the lack of immunoprophylactic measures. Timely vaccination of gestating sows provides natural lactogenic immunity in piglets, preventing significant economic losses resulted from the death of sick animals and the expenses spent for therapeutic measures.

Introduction

The main principle in practical struggle against infectious diseases is the severance of epidemic chain in any of its loops or prevention of epidemic process transformation into other infection forms.

Immunoprevention changes the relationship between protective forces of animal body and pathogenesis of microorganisms and is considered to be one of the measures to prevent all forms of an epidemic and contribute to the interruption of the epidemic chain in a specific flock. Contagious diseases are endowed with high propagation rate and ability to cause mass animal infection. Hence, they are very dangerous and exert negative socio-economic effect, whereby affecting common state interests.

Immunoprevention is the integral part of the total strategic and tactical measures against infectious diseases, and in case of its correct implementation the hazards, though not completely eliminated, significantly get declined. The purpose of immunization is not to eradicate infectious diseases, but to timely prevent the disease of animals in the given area (Annikov, et al., 2010, Kislenko, 2012, Kolyakov, 1991, Petrov, 1984).

In pig breeding, when there is a great number of animal units, immunoprophylaxy is considered to be the crucial component for infectious disease prevention; so, it should be included in the production process and fit with the technological procedures, so that animals could be provided with full immune protection.

Pig breeding safety can be violated by a number of microbial diseases, which are characterized by high infectivity and propagation rate for a rather short time, which leads to considerable financial losses; Pasteurellosis, Salmonellosis, Streptococcosis, etc., are among these diseases. So, for the target research we have chosen pig farms, where no preventive measures against the infection diseases have been implemented.

Materials and methods

The research work was carried out in 2021 in a private pig breeding farms of Kotayk region. The livestock, not exceeding 140-160 animals, included 18-20 sows, 80-100 units of 1-4 months old piglets, and 30-40 units of above-6-month-old fattened pigs.

Epizootological, clinical and post-mortem diagnosis of the fallen animals per pathoanatomical examination was carried out in these pig farms. The calculation of economic losses, as well as estimation of the effectiveness of veterinary measures was carried in line with the formulae set out in the textbook on veterinary economics (Grigoryan, 2005).

Studies have been conducted in the laboratory of the department of Epidemiology and Parasitology of Armenian National Agrarian University. Blood taken from the heart of the animals died of clinically pronounced diplococcal infection or those subjected to forced slaughter but not having been treated with antibiotics, their liver, spleen, tubular bones, pieces of lungs taken at the borders of healthy and affected tissues and lymph nodes served as a pathological material for laboratory investigations. Smear-prints were prepared from the pathological material and sowing from the same material was carried out into the universal nutrient media: meat-peptone agar and meat-peptone broth at a concentration of 7.2 hydrogen ions, followed by incubation in a thermostat at the temperature of 37-38 ^{0}C for 24-48 hours. Bacterial smears prepared from both pathological material and colonies grown on nutrient media were stained using the Gram method (Antonov, et al., 1986, Baryshnikov, 2019, Gosmanov, 2014, Zykin, 2006). Microscopic examination of the stained smears identified oval and lanceolate cocci measuring 0.6-1.0 microns, arranged in pairs and in the form of chains (Figure 5).

Results and discussions

In order to identify the epizootological conditions in the pig farms of Kotayk region, relevant monitoring was carried out, which is a specially organized sequential control, implying ongoing data collection on a specific infectious disease.

In the investigated farm, animals affected with different forms of diplococcal infection were detected. In piglets aged from one to three months, the superacute (infectious-toxic) and acute forms of the disease prevailed. Sick piglets refused feeding, were motionless, from time to time muscular tremor was observed and body temperature fluctuated within 40-42 ^{0}C. Breathing was rapid and heavy, sometimes prior to falling, asphyxia was observed due to pulmonary edema, manifested by wheezing, foamy discharge from the nostrils, bluishness of visible mucous membranes, thread-like arrhythmic pulse. The acute form of the disease was characterized by general weakness, lack of reaction to external stimuli, redness of the conjunctiva and lacrimation. In parallel with septic changes, diarrhea was observed, feces were liquid with traces of mucus and blood. As a result of diarrhea, animals were rapidly emaciated and weakened.

In young animals aged from two to four months, a subacute and chronic course of infection with articular, pulmonary and mixed forms of the disease was observed. The affected joints were pain-sensitive, swollen, with an increased local temperature, which was manifested by the lameness of sick animals (Figures 1, 4). Sometimes signs of inflammation in the area of the affected joint disappeared with subsequent occurrence in other joints of the same or other limb. The pulmonary form was manifested by catarrhal pneumonia, seromucous discharge was observed from the nostrils at first, later transforming into purulent discharge. The cough, initially dry and rare, subsequently became moist, frequent and painful. The fever was not constant, the appetite was fickle.

Very often, purulent mastitis and metritis were observed in sows after parturition.

In the case of superacute course of the disease, only massive hemorrhages in the gastrointestinal tract, in the peritoneum and the outer and inner membranes of the heart were observed in the animals that fell and were subjected to forced slaughter. In the acute intestinal form of infection, the disease was manifested by the presence of hemorrhagic exudate in the abdominal cavity, hemorrhages on the mucous membranes of the stomach and intestines. The liver was somewhat enlarged, clay-colored. The spleen was swollen and enlarged, sometimes dark cherry-colored with a tense capsule, rounded edges and a rubber-like consistency. In the pulmonary form of the acute course of the disease, foci of hemorrhagic and serous inflammation were observed, the mucous membranes of the trachea and

Figure 1. Joint damage.

Figure 2. Lung abscess.

Figure 3. Hemorrhagic pneumonia.

Figure 4. Autopsy picture.

bronchus were hyperemic and covered with mucopurulent exudate. Mediastinal lymph nodes were enlarged, hyperemic. The surface of the pulmonary and costal pleura was covered with fibrin membranes and adhesive pleurisy and pericarditis were observed.

Pathological changes in the subacute and chronic course of infection were observed both in the respiratory organs and in the digestive system and in the joints. Granular necrotic and purulent foci of inflammation, abscesses with the size of a pea to a chicken egg were found in the lungs (Figures 2, 3).

Sporadic forms of the disease manifest themselves throughout the year, however, depending on predisposing factors, it can occur in the form of epizootic outbreaks, the intensity of which depends on the number of susceptible animals, as well as on keeping and feeding conditions.

According to the literature, the lethality/mortality of animals in case of diplococcal infection reaches 30.9 %; however, in the case of epizootic outbreaks, 30-50 % of piglets are infected, and accordingly, the mortality ranges from 70 % to 90 % (Grigoryan, 2002, Aliyev, 2020, Lapytov, 2019, Pleshakova, 2019, Chepurov and Cherkasova, 1963).

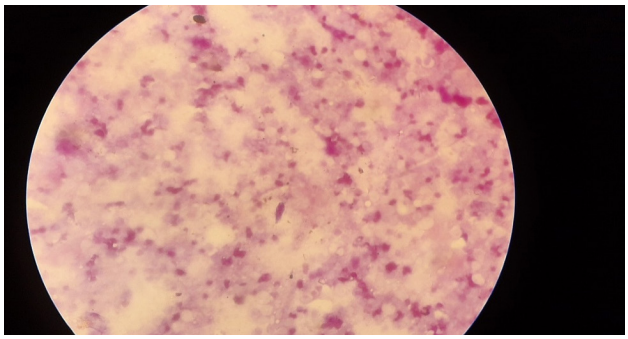

Figure 5. The causative agent of diplococcal infection under a microscope.

The actual economic damage is caused by the death and forced slaughter of the animals, as well as due to the expenses spent for therapeutic and preventive measures. On the example of one of the pig farms subjected to epizootic monitoring, we calculated the effectiveness of veterinary measures. The actual damage caused by the death of pigs with diplococcal infection was calculated using the following formula:

$$D1 = N \times W \times C - SP.$$

In this formula, $D1$ is the actual economic damage caused by the death of sick pigs, N is the total number of dead animals, W is the average live weight of dead pigs in this age group expressed in kilograms, C is the average cost of live weight of a healthy animal unit in conventional units, and SP is the profit received from the sale of slaughter products in case of forced slaughter of sick animals, expressed in drams.

The live weight of one-month-old piglets averaged 8 kg. Since the net slaughter yield of pigs is 80 %, and the market value of one kilogram of pork is on average 2900 drams, the cost of one kilogram of live weight (C) will be estimated as 2320 drams. A total of 10 piglets fell, the corpses of which were destroyed by incineration, which means the profit from the sale of slaughter products is zero. The actual damage caused by the piglets' death was

$$D_1 = 10 \times 8 \times 2320 - 0 = 185600 \text{ drams.}$$

Depending on the number of dead animals, the actual economic damage can be amounted to huge amounts.

Currently, monovalent and polyvalent vaccines have been proposed for the prevention of diplococcal infection of piglets, out of which the inactivated polyvalent formol vaccine against paratyph, pasteurelosis and diplococcal infection of pigs (PPD) have the greatest practical application. In vaccinated animals, immunity to the above stated infections is formed 12-12 days after the second

injection and persists for 6 months. Natural passive (dairy) immunity in piglets born from vaccinated sows persists for one month after birth.

According to the instructions, pregnant sows are vaccinated 15-40 days before parturition, and piglets can be vaccinated at 20-30 days of age. Pregnant sows are vaccinated three times: 35-40 days before parturition vaccination dose is 5 ml, 25-30 days before parturition it makes 10 ml and 15-20 days before parturition vaccination dose makes 10 ml. Piglets are vaccinated twice: the first time the vaccine is administered 7-10 days before separating piglets from their mothers /weaning/ with the dose of 3 ml, and the second time – 5-7 days after the first injection with the dose of 4 ml. 25 ml is spent for the vaccination of one pregnant sow, and 7 ml of vaccine is spent for vaccination of one piglet. One bottle of vaccine with a holding capacity of 100 ml is sold averagely for 1100 drams in veterinary pharmacies. So, let's try to estimate the economic efficiency of veterinary measures (in our case it is vaccination) via the following formula:

$$Pd1 = M_n \times K_m \times K_{ed} - d,$$

where $Pd1$ is the damage prevented as a result of a preventive measure, M_n is the number of susceptible animals subjected to preventive vaccination, K_m is the morbidity coefficient of animals with this disease (defined as the ratio of the number of sick animals to the number of animals susceptible to this infection), K_{ed} is the coefficient of economic damage in relation to one sick animal (defined as the ratio of the actual economic damage to the number of sick animals) and d is the actual economic damage, which is calculated as zero in the disease-resistant farms.

In the pig farm under study, 100 piglets were vaccinated, while in a neighboring vulnerable farm, where 30 out of 100 piglets got sick, the morbidity rate was 0.3, and the economic damage coefficient per piglet was 6187 drams, which means that the prevented economic damage due to vaccination will be:

$$Pd1 = 100 \times 0.3 \times 6187 - 0 = 185610 \text{ drams.}$$

The economic efficiency of the veterinary measures carried out is determined by the formula $Ev = Pd - Cv$, as the difference between the prevented damage and veterinary costs expressed in drams (the cost of the biological product used). In the case under consideration, the effectiveness of the conducted immunoprophylaxis is:

$$Ev = 185610 - 1100 = 184510 \text{ drams.}$$

The economic efficiency of the veterinary measures per dram spent is defined as the ratio of the economic efficiency of the measures carried out to the veterinary costs according to the formula $Ee = Ev / Cv$. In the case we are considering, this indicator will be:

$$Ee = 184510 / 1100 = 167.8 \text{ drams.}$$

As a result of preventive vaccination carried out in the pig farm, damage equal to 185610 drams was prevented, and each dram spent was reimbursed in the amount of 167.8 drams.

Conclusion

Taking into account the data of epizootological, clinical and laboratory studies, it can be concluded that diplococcal infection is a common disease in pig farms of the republic. The spread of the disease is facilitated by the poor sanitary condition of farms, poor keeping and feeding conditions of animals and, mostly by the high concentration of pigs in confined spaces and lack of immunoprophylaxis. Young pigs are susceptible to the disease, while adult pigs are bacterial carriers.

For the prevention of diplococcal infection, highly effective mono and polyvalent vaccines have been proposed, which can be used in both safe (disease-resistant) and unprotected farms.

Currently, diplococcal infection has been registered in the pig farms of Kotayk region of the Republic of Armenia. As a result of epizootological, clinical, pathoanatomic and laboratory studies, it was found out that the disease mainly occurs in the form of small epizootics among piglets aged from 1 to 4 months old. Besides, the disease is mainly registered in the pig farms, where planned immunoprophylaxis is not carried out.

Summarizing the results of the preventive measures carried out, it can be concluded that vaccination of sows and piglets in the pig farms surveyed by our research group makes it possible to prevent significant economic loss and demonstrates high efficiency in the immunoprophylactic measures carried out.

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