UDC 619:616.98:578.832.1:578.831.11:616-076

DOI 10.29326/2304-196X-2018-1-24-3-7

HISTORY OF HIGHLY PATHOGENIC AVIAN INFLUENZA ERADICATION IN RUSSIAN FEDERATION IN 2016–2017

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SUMMARY

Epidemic patterns of highly pathogenic avian influenza A/H5N8 spread in the Russian Federation are demonstrated, history of the disease outbreak eradication in domestic poultry is described, basic reasons of the dangerous virus introduction on the commercial farms are analyzed and issues of the outbreak containment are highlighted. Specific properties of H5N8 disease progression and clinical manifestation are demonstrated against H5N1 disease. Data of epidemic investigations of the virus introduction to the closed-type farms are integrated. Basic attention is given to the destruction of poultry died and stamped out during implementation of anti-epidemic measures, and potential alternative ways of biological waste destruction are demonstrated. Principal risks of introduction of emerging influenza virus subtypes into the Russian Federation are determined. Further spread of avian influenza over the Russian territory is expected due to the current epidemic situation, the virus persistence in the vectors, maintenance of its viability in the environment and seasonal migrations of the wild birds. Major threat of the agent introduction comes from the neighbouring East Asia and Far East countries (China, Japan, Korea). Herewith, introduction of potentially zoonotic viruses is also possible. Risk of the virus introduction from the European countries, Near East countries and Central Asia cannot be excluded. For now, drastic measures still remain the only tool for the disease control and the strategy of limited targeted AI vaccination in the backyards minimizes the virus introduction to the commercial farms located in the risk zones.

Key words: highly pathogenic avian influenza, H5N8, outbreak, anti-epidemic measures.

INTRODUCTION

Highly pathogenic type A avian influenza virus (Influenza A virus) is persistently circulating in wild bird population in a number of countries, it induces outbreaks of lethal disease in poultry thus causing grave social and economic damage. The "obsolete" term of the disease gives evidence of its danger – classical fowl plaque. The dominating virus reservoir naturally includes aquatic and semi-aquatic birds. It is worth mentioning that over the recent years a tendency to epidemic strain change has been observed: before 2014, H5N1 virus was prevailing and currently the virus with H5N8 antigenic formulae is widely circulating. Such virus subtype has been reported in wild bird and poultry population in European, Asian and African countries. Herewith, all notified cases of this subtype-induced disease reported in wild avifauna are associated with bird mortality that was previously not typical for wild waterfowl. Species composition of birds died of this pathogen is diverse: *Cygnus olor* – mute swan, *Aythya ferina* – common pochard, *Aythya fuligula* – tufted duck, *Podiceps cristatus* – great-crested grebe, *Falco peregrinus* – peregrin falcon, *Netta rufina* – red-crested pochard, *Buteo buteo* – common buzzard, *Ardea cinerea* – grey heron, *Tachybaptus ruficollis* – little grebe, *Haliaeetus albicilla* – white-tailed eagle, *Streptopelia decaocto* – Eurasian collared dove, *Anser anser* – gray lag goose, *Accipiter nisus* – sparrow-hawk, *Falco vespertinus* – red-footed falcon, *Accipiter gentilis* – goshawk, *Anas penelope* – European wigeon, *Gallinula chloropus* – common moorhen, *Cygnus cygnus* – whooper swan; *Tyto alba* – barn owl, *Branta canadensis* – Canada goose, *Anser albifrons* – white-fronted goose; *Laridae*, *Corvidae*, *Ciconiidae* and *Numididae* birds [8]. In the Russian Federation, highly pathogenic H5N8 virus was originally isolated from dead wild birds during active AI monitoring carried out on Uvs Nuur Lake, Republic of Tyva, in the period of spring migration. Subsequently the virus started its circulation in poultry.

Fig. 1. Severe cyanosis of claws of H5N1 influenza diseased chicken

In late 2016 – early 2017, highly pathogenic avian influenza epidemic situation in the Russian Federation deteriorated. AI outbreaks in poultry population were associated with the virus of novel for Russia genotype – 2.3.4. Thus, starting from late 2016, H5N8 influenza outbreaks were reported in the Astrakhan, Rostov, Moscow, Nizhny Novgorod, Samara Oblasts, Krasnodar Krai, Republics of Tatarstan, Mari El, Kalmykia and in Udmurt and Chechen Republics. Outbreaks of quarantine infection caused huge economic losses to commercial poultry farms in Astrakhan, Rostov, Moscow Oblasts and Republic of Tatarstan. The virus infected chickens, guinea fowl, geese, ducks, and turkeys.

Wild bird migration is one of the key factors that definitely affect the development of AI epidemic situation; and occurrence of new disease outbreaks cannot be excluded due to infeasibility of wild avifauna control.

MATERIALS AND METHODS

Standard methods of epidemic investigations were used. The investigation data were systemized and subjected to epidemic analysis. Autopsy, sampling and transportation of pathological samples were performed according to SP 1.3.3118-13 "Safe handling of pathogenicity (hazard) group I and II microorganisms"; SP 1.2.036-95 "Procedure for record, storage, transfer and transportation of pathogenicity group I-IV microorganisms"; Veterinary rules of avian influenza A laboratory diagnosis approved by the RF MoA Order of April 3, 2006 No. 105.

Initial diagnosis was made in the laboratories of the RF Subjects; their diagnoses were confirmed by the FGBI "ARRIAH". Photo- and video recording devices were used during the visits to the poultry farms.

Fig. 2. General depression

RESULTS AND DISCUSSION

Spread of highly pathogenic avian influenza H5N8. In late 2016-early 2017, wide spread of highly pathogenic influenza H5N8 virus was reported in poultry and wild birds. The influenza virus was introduced onto large commercial poultry farms in the Astrakhan, Moscow, Rostov Oblasts and Republic of Tatarstan. As part of the anti-epidemic measures 2,592,019 commercial poultry were destroyed that amounted to 0.57% of total bird population housed on poultry farms in Russia. In addition, since late 2016 influenza of this subtype has been reported on backyard farms and small poultry farms in Krasnodar Krai, Republics of Kalmykia, Tatarstan and Mari El, in Udmurt and Chechen Republics, and in Moscow, Samara and Nizhniy Novgorod Oblasts. The number of destroyed poultry amounted to 9,513 birds – 0.009% of poultry population housed on the farms of the above-mentioned types. Total amount of birds destroyed as a result of anti-epidemic measures reached 2,601,532 birds.

Influenza H5N8 clinical and post-mortem signs. Anamnestic data collected during epidemic investigations of highly pathogenic influenza H5N8 cases reported in poultry population including cases of the virus introduction on the closed-type commercial farms demonstrated that no influenza-typical pathognomonic signs could be identified on the early stage due to hyperacute disease cause. While clinical disease of birds infected with A/H5N1 virus-associated influenza included cyanosis of the comb, jowls, claws that became of purple color (Fig. 1), influenza caused by H5N8 virus developed more rapidly: birds suddenly refused from water and feed, developed coma-like state and died in several hours (Fig. 2). The infection period can be hard to determine in this case due to the short incubation period of the disease. Post-mortem examination of birds died of influenza H5N8 often demonstrated the following post-mortem lesions: petechiae in abdominal fat and serous membranes (Fig. 3–5); acute pancreatitis (edematic, loose and unevenly colored pancreas; easy to rapture parenchyma and blood-filled vessels), (Fig. 6, 7); splenomegaly (enlarged spleen with uneven dotty pattern, flabby structure and excessive necrotic debris) (Fig. 8); duodenitis and enteritis (unevenly hyperemic and edematic mucous membranes of small intestine; mucous exudate in the lumen; blood-filled vessels of the serous membrane); hepatosis (enlarged, soft textured liver of uneven maddy color; the liver was easy to rupture and demonstrated necrotic debris at the site of the cut); petechia and expressed blood-filling in reproductive organs (Fig. 9). In some cases internal bleeding was reported.

Causes of the influenza virus introduction on the closed-type poultry farms. The basic cause of the virus introduction onto the closed-type farms is associated with the shortcomings in the biosecurity of the farm. As experi-

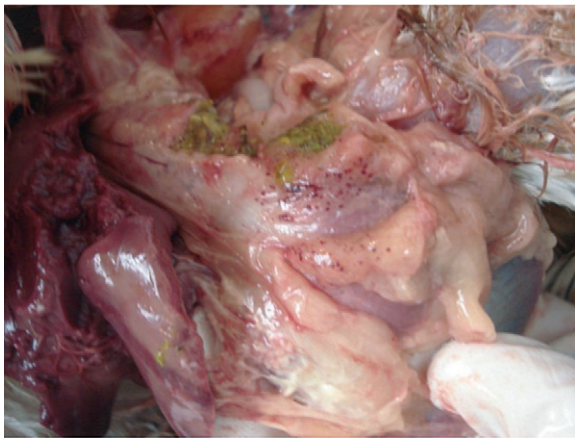

Fig. 3. Petechiae in abdominal fat of chickens

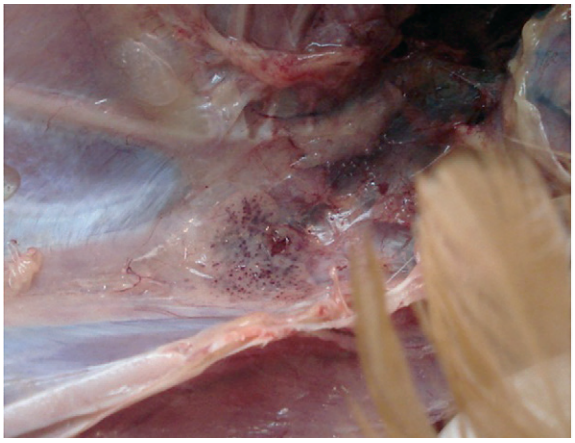

Fig. 4. Hemorrhages on serous membranes (dead chickens)

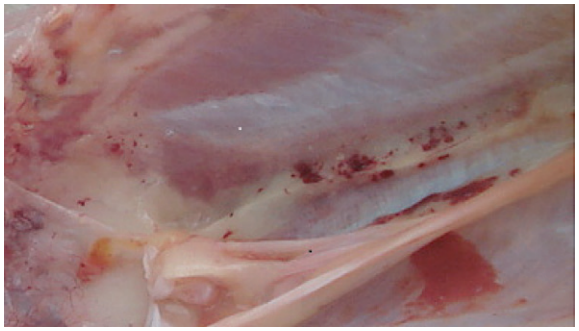

Fig. 5. Hemorrhages on the inner side of chest cavity of dead chicken

Fig. 6. Acute pancreatitis, duodenitis (turkey)

ence shows, the basic reasons of the biosecurity system failure include violation of the veterinary and sanitary rules by the personnel, lack of heat treatment of feed, access of synanthropic and wild birds to the poultry feed on the farm and contamination of compound feed with their feces, absence of vehicle disinfection, lack of knowledge on biosecurity among the personnel, absence of operational washing and changing facilities, negligence of intercycle prophylaxis intervals, etc. Natural influenza virus reservoir is known to be wild waterfowl, who migrate over the long distance and maintain the virus circulation and its existence as a biological species [5]. Synanthropic birds can be a peculiar virus vector from the wild birds to the poultry population. Fecal-oral route of the infection transmission facilitate the intensive virus spread as high concentrated pathogen is excreted with the feces of the infected birds. Use of wild bird feces contaminated feed and litter is the prevailing factor of the virus introduction onto the farm. Thus, sunflower seed hulls contaminated with the feces of wild and synanthropic birds used as a litter were one of the most probable causes of the initial virus introduction onto one of the poultry farms in the

Fig. 7. Acute duodenitis, pancreatitis (chickens)

Fig. 8. Splenitis (chickens)

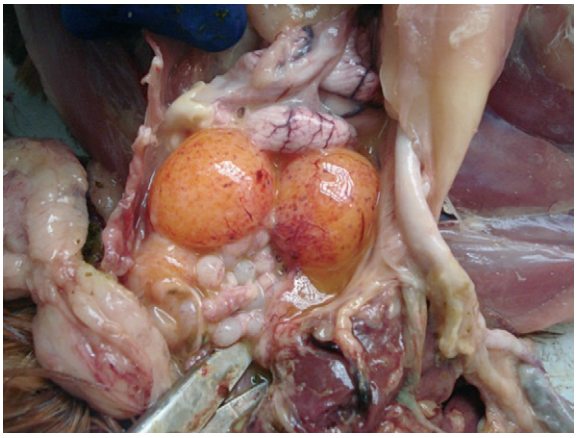

Fig. 9. Plethora and hemorrhages in reproductive organs of dead chickens

south of Russia. Backyard poultry owned by people working on the farm can also be a factor of the virus introduction to the farm.

In order to minimize the risk of pathogen introduction to the RF farms there are effective Veterinary rules of poultry keeping on the closed-type poultry farms (poultry establishments) approved by the RF MoA Order of April 3, 2006 No. 104. These rules are mandatory for business operators involved in poultry raising and breeding [1].

Anti-epidemic measures for HPAI outbreak containment in the Russian Federation are taken in compliance with the Rules of avian influenza control approved by the RF MoA Order of March 27, 2006 No. 90 [4]. Avian influenza (H5, H7) is one of the highly dangerous diseases that require quarantine and disease control measures, which are based on a mechanism aimed at epidemic chain disruption thus providing for interruption of the epidemic process persistence. Efficacy of the anti-epidemic measures is highly influenced by timely laboratory confirmation of the diagnosis. Quarantine imposition implies strict measures to be taken, first of all, for rapid eradication of the source of the infection as well as for the elimination of the virus transmission factors. To this effect, all the diseased and susceptible birds in the infected settlement are stamped out and destructed. Herewith, all necessary measures are taken to exclude the virus spread in the environment that can potentially lead to more drastic consequences. Movement of final products is banned and such products are subject to destruction. During anti-epidemic measure implementation, a complex of special and general sanitary measures is taken. EMERCOM teams are engaged for rapid containment of highly dangerous disease outbreaks. Zoning includes establishment of infected zone (5 km radius from the border of the infected settlement) and surveillance zone (10 km radius from the infected settlement).

Of particular importance is the issue of bird destruction during the outbreak containment. In the Russian Federation destruction and disposal of bird carcasses is performed according to the Veterinary and sanitary rules of collection, disposal and destruction of biological wastes approved on December 4, 1995 No. 13-7-2/469. These rules prescribe specific procedure for the destruction of the carcasses of birds died or stamped out during the containment of a highly dangerous disease outbreak. In case of highly pathogenic avian influenza the biological wastes are destructed by on-site pyre burning, in the incinerators or in the specifically designated areas. However, the rules also specify other procedure for destruction, which can be used in exceptional cases. Thus, animal carcasses may be buried in case of mass mortality of animals due to emergency and infeasibility of their carcass transportation for disposal, incineration or composting. If referred to the definition, the emergency is an Act of God or a process resulting in emergency and significant damage. Major diseases of humans and livestock (epidemics/ epizootics, pandemics/panzootics) are also qualified as biological emergencies. The pain points of pyre burning include impossibility of rapid inflammation of the biological wastes and incomplete carcass combustion to ash. Pyre burning additionally requires much time and extra expenses (purchase of combustibles, forced air feeding, etc.).

Analysis of the international experience in poultry carcass destruction demonstrated that burial/composting is a more eligible, rapid and efficient way of biowaste destruction as compared to pyre burning. On-site burial is the best alternative to the biowaste transportation to the disposal sites [6, 7]. Research results demonstrate that during composting the influenza virus is inactivated within 10–15 days under core temperature 40–60 °C and above. However, nonconformity of temperature in bulk of composted biological wastes should be regarded, thus the composing pits shall not be opened for a long periods.

Pyre burning method was used on all influenza H5N8 infected commercial farms (excluding one farm) during the containment of the outbreaks in 2016–2017 (Fig. 10, 11). Five to ten days are required for burning of all dead and stamped out birds.

Influenza H5 or H7 is included in the List of diseases, which envisage seizure of animals and animal product confiscation [2]. According to paragraph 9 of the Rules of animal seizure and animal product confiscation for containment of highly dangerous animal diseases, all citizens and legal entities have a right for compensation for losses suffered due to such actions [3]. During the disease outbreak containment, the available compensation tool serves as a stimulus for the citizens not to conceal mass mortality of poultry.

In all cases, the quarantine of the infected settlements was lifted in 21 days after the stamping out and final disinfection. Restrictions were in effect for at least 3 months after the quarantine lifting.

CONCLUSION

Strict quarantine and other measures taken for highly pathogenic avian influenza eradication in the poultry population allowed to stop the epidemic and to prevent further spread of the virus in the Russian territory. In total, 2 601 532 poultry birds were destroyed. Rapid evolution of the avian influenza virus and its ability to cross species barrier drive specific attention to the agent ecology and necessitate tough anti-epidemic measures to be taken for the disease outbreak containment. Epidemic situation analysis demonstrates that the situation on avian influenza is unstable and it is changing annually that is, in its turn, preconditioned by the ecological flexibility of the AI virus due to its rapid genetic evolution. Heterogenicity of Type A influenza virus population during its epidemic spread

Fig. 10. Arrangement of anti-epidemic measures: trench for bird carcass burning

Fig. 11. Pyre burning of bird carcasses in the trench

and typical segmented genome facilitate rapid selection process due to genetic drift and genetic shift. As different genetic lineages of the influenza virus are spread over the wide area, introduction of exotic strains including H5N6 strains into the Russian Federation cannot be excluded. For now, drastic measures remain the only tool for eradication of highly pathogenic avian influenza outbreaks and they shall be aimed at epidemic chain disruption and epidemic process termination.

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