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Popular Article

African swine fever: A threat to Indian pigs

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Abstract

Introduction

Rural livelihoods and the growth of the nation's economy depend on the livestock and animal husbandry sectors. India has one of the world's largest livestock wealth, with the livestock industry accounting for one fourth of agricultural GDP. Pig is an important livestock species because it is raised by socioeconomically weaker members of society. Pigs have a larger potential than other livestock species to help farmers achieve faster economic returns because of their inborn traits, which include high fecundity, high feed conversion efficiency, early maturity, and short generation intervals. In 2019, there were 9.06 million pigs in the country, and decreases12.0% from the previous Livestock Census (2012). Pigs make up around 1.7% of all livestock.

African swine fever (ASF) is a virus that kills farm and wild pigs with a high fatality rate that frequently exceeds 100%. This illness can affect pigs of all ages. The main clinical symptoms include blue-purple cyanosis of the snout, ears, tail, and lower legs, a high temperature, and a huge amount of discharge from the eyes and nose. The World Organization for Animal Health (OIE) classifies ASF as "notifiable diseases."

2. History

The sickness caused by this virus was initially detected in Kenya in 1920. The disease later invaded Europe (Portugal) in 1957 and was successfully controlled, but it re-entered Portugal in 1960

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and spread throughout the Iberian Peninsula and the rest of Europe. Furthermore, it expanded to the Russian Federation in 2007 and to China in 2018, after which it reached Vietnam, Myanmar, and finally India.

On May 21, 2020, the OIE reported a total of 11 outbreaks in the Indian states of Assam and Arunachal Pradesh, where 3701 pigs died from ASF (India report the first outbreak). The disease has spread to Northeastern states by June 2021, including Meghalaya, Mizoram, Manipur, and Nagaland, which had a high death rate among pig producers. A recent outbreak was found in some district of Rajasthan in February 2023.

3. Epidemiology

In Africa, Europe, and Asia ASF has a distinct pattern of transmission and spread. Three ASF epidemiological cycles, including the sylvatic, tick-pig, and domestic cycles, are described below:

In the sylvatic cycle, the virus is transmitted from warthogs to soft ticks without the warthogs being sick.

In the tick-pig cycle, Ticks act as a biological reservoir for the virus and infectious agents are transmitted among domestic pigs. Such cycles were observed during the Iberian Peninsula outbreak in the 1960s and 1970s as well as in other sub-Saharan regions of Africa.

In the domestic cycle, Natural reservoirs are not important but domestic pigs or pig products responsible for disseminate the virus in domestic herds.

The hypothesized wild boar-environment cycle, a novel and fourth cycle of transmission described in some regions of Europe, involves Eurasian wild boar, its habitat, and their carcasses. ASF outbreaks in the domestic cycle are also linked to pig husbandry's social and economic characteristics.

4. Etiology

The virus that causes ASF is ASFV, a member of the family Asfarviridae and genus Asfivirus. On the basis of its morphology, it was initially categorised within the family "Iridoviridae," but subsequently, as a result of changes in its mechanism of replication and DNA structure, it was classified independently as the only member of the family Asfarviridae.

ASFV is a large ds DNA virus that multiplies in the cytoplasm of cells. Asfarvirus virions have a complex icosahedral capsid that measures 180 nm in diameter and enveloped is 175-215 nm in diameter. The virus's genome is a single molecule of linear, ds DNA that is between 170-190kbp

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in size, with covalently closed ends, inverted terminal repeats, and hairpin loops. It codes for between 150kbp and 167kbp proteins, including those necessary for viral replication. (Dixon et al., 2013). Macrophages are the primary cell type for ASFV replication. For the pathogenic and immune evasion strategies, the virus must modify macrophage activity. It is well known that the virus is highly resistant to low temperatures, At 56°C for 70 minutes or 60°C for 20 minutes, ASFV becomes heat inactivated. In addition, it is inactivated by pH 11.5 in serum-free medium.

5. Host Range

African swine fever is an OIE listed transboundary disease that infects members of Suidae family such as domestic and wild boars (Sus scrofa ferus), feral pigs, bush pigs (P. porcus), warthogs (Potamochoerus aethiopicus), forest hog, and Ornithodoros ticks (Soft ticks Ornithodoros moubata in Africa and Ornithodoros erraticus in Europe).

6. Transmission

ASF can spread not only through direct contact but also through eating meat from infected pigs (Wilkinson, 1984), being bitten by infected ticks (Ornithodoros spp.), and coming into contact with bedding, feed, equipment, clothing, and other items that have been contaminated with biological material that contains viruses, such as faeces, urine, or saliva from infected pigs.

Although warthogs are thought to be the virus's natural hosts, it has been shown that they are unable to directly transfer the virus to domestic pigs. After feeding on the viremic pig, the ASFV is kept in biological vectors (soft ticks), where it can spread the virus to other pigs. Depending on the virus, the host, the dosage, and the route of exposure to the virus, the death rate ranges from 0 to 100% (Costard et al 2013).

7. Pathogenesis

ASFV has an incubation period of 4 to 19 days (Arias and Sánchez-Vizcaíno 2002). The digestive tract is the primary natural route of infection, although there are also additional pathways such as the respiratory system, skin injuries, and insect bites. When viruses enter the body, they first multiply in mononuclear phagocytic cells, primarily on monocytes, however macrophages can also infect endothelium and hepatocyte cells. After then, viruses move through the blood and lymph, causing primary viremia within 8 hours of infection in the case of newborn piglets, and secondary viremia to happen between 15 and 24 hours later, when they further spread to practically all tissue from the primary sites. After 30 hours of post infection, it can move to the target organs, such as the spleen, bone marrow, liver, lung, and kidney, producing significant bleeding after damaging the

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macrophages. One day after infection, the virus can be detected in the blood's circulating leukocytes, tonsils, and mandibular lymph nodes (Heuschele, 1967). Active molecules such as cytokines, complement factors, and arachidonic acid metabolites are released, which mostly responsible for organ damage (Penrith *et al.*, 2004). Infections that are acute and subacute can cause thrombocytopenia (Blome *et al.*, 2013).

8. Clinical Signs

The disease might manifest as acute, subacute, chronic, or peracute sickness and some animals may seroconvert to ASF without developing symptoms:

8.1 Peracute Form: Sudden deaths with few lesions (peracute cases) may be the first sign of an infection in some herds.

8.2 Acute Form: High fever, anorexia, lethargy, weakness, recumbency, and cutaneous hemorrhages are symptoms of acute instances (redness of skin on ears, abdomen and legs). There have been reports of neurological symptoms, nasal and conjunctival discharges, and respiratory symptoms (including dyspnea). Pigs may also vomit or have diarrhea, and pregnant animals commonly have abortions. Death usually happens within 7 to 10 days. The mortality rate might reach 100%.

8.3 Subacute Form: Subacute African swine fever is similar to acute form, but with less severe clinical signs. Occasionally, the emergence of this type is detected by an abortion. Typically, affected pigs pass away or recover in 3 to 4 weeks.

8.4 Chronic Form: Pigs with the chronic form have nonspecific signs such as an intermittent low fever, appetite loss and depression but some pigs develop respiratory problems and swollen joints. There has been evidence of intermittent vomiting, diarrhea, and frequent coughing.

9. Post Mortem Lesions

Depending on the strain and species of pig affected, post-mortem lesions for African swine fever might include bluish coloring of the skin with bleeding, bloody froth from the nose and mouth, discharge of pus from the eyes, and signs of bloody faeces.

ASF-specific lesions are seen, particularly in the acute phase, when petechial hemorrhages are evident on various internal organs, including the spleen, lymph nodes, kidney, heart, and bladder. Splenomegaly is also present, and hemorrhages are also evident on the dura mater in the brain and in the pleura. Subacute infection makes kidney hemorrhage more obvious than acute infection does. In its chronic phase, necrotic skin is seen. (Wozniakowski et al., 2016).

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10. Diagnosis

The clinical signs of African swine fever resemble to classical swine fever extremely closely, diagnose the two illnesses using a laboratory test.

Clinical symptoms and laboratory testing are used to make the diagnosis. Identification of the agent by isolation in cell cultures demonstrating hemadsorption and antigen detection. By using a fluorescent antibody test (FAT), antigens can be detected. The viral genome may be detected using polymerase chain reaction methods, which are especially helpful when samples may not be acceptable for virus isolation or antigen detection due to putrefaction. For diagnosis, serological tests such as the Enzyme-linked immunosorbent assay (ELISA), which is the standard test for global trade, the indirect fluorescent antibody (IFA) test, and the Immunoblotting test can be utilised.

11. Differential diagnosis

It is critical to distinguish between African Swine Fever and other septicaemic diseases like Pasteurellosis, Erysipelas, Salmonellosis, Aujeszky's disease (pseudorabies), Porcine Reproductive and Respiratory Syndrome (PRRS), Classical Swine Fever (Hog Cholera), Porcine Dermatitis and Nephropathy Syndrome (PDNS), Porcine Reproductive and Respiratory Syndrome (PRRS) and toxicity.

12. Prevention and Control

Interrupting the mechanisms of viral transmission is the main goal of ASF prevention. First, to prevent direct contact transmission, practice good farm biosecurity measures to prevent contact between any infected and susceptible swine. This should involve keeping infected pigs apart from the herd, avoiding interaction between pigs and feral or wild hogs, housing pigs indoors where practical, and quarantine the new herd for at least 30 days to ensure health

I. Strict import regulations for animal products: must be put in place to prevent the introduction of infected live pigs or pork products into areas that are clear of ASF. Animal imports from countries with ASF contamination may be subject to limitations or outright bans in the wake of the discovery of tainted meat. Look into polluted regions before importing any potentially dangerous items.

II. Proper disposal of all food waste from aircrafts or ships coming from infected countries. Furthermore, no human food waste should be provided to pigs.

III. Efficient sterilization and disposal of garbage: Swill feeding should be avoided (i.e. garbage feeding). Catering waste feeding is a high-risk activity; if the food waste contains ASF, it can infect a healthy herd. Do not leave food trash out for wild swine species to eat. Carcasses, wasted

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components from butchered pigs, and food waste should be properly disposed of.

IV. Rapid slaughtering of all pigs, infected or not (stamping out): Animals that have recovered or survived are viral carriers for the rest of their lives. As a result, it is safer to butcher both diseased and possibly infected pigs to avoid spreading the disease and preventing recurrence. Stamping out the illness is frequently a temporary solution. However, it is often the most cost-effective strategy that enables farms to be free from ASF in the shortest time.

V. Strict on-farm biosecurity: By following biosecurity regulations, such as thoroughly cleaning clothing and footwear, and by avoiding from introducing pig products that have not undergone the appropriate heat treatment into a farm, viruses and germs may be kept out. Farms should have a special pair of shoes and outfit that is only worn on the farm.

VI. Controlled animal and human movements: People, tools, and vehicles are all ASF targets. Make sure anyone entering the farm hasn't interacted with any pigs in the last 48 hours. Visitors to the farm who have been through ASF-positive nations must quarantine at least five days before to enter. Before entering the building, vehicles and equipment should be thoroughly cleaned and sanitized.

VII. Disease surveillance and monitoring: This is crucial for shipping live pigs and items containing pork. Pig farms should also have a strict program for health monitoring. The presence of ASF should be checked on all ill or deceased pigs. Pigs killed for in-house eating should be examined by a veterinarian to spot ASF early.

VIII. Effective and early diagnosis of the virus by laboratory testing: As soon as you see any symptoms of ASF, contact your veterinarian and get your pigs tested.

13. Control

General approach to control ASF disease

- ASF must be contained at the site where it is detected and eradicated as quickly and effectively as possible so that it cannot be reintroduced.
- Early identification of clinical symptoms indicative of African Swine Fever (ASF) and fast reporting to enable diagnosis as soon as ASF reaches the nation.
- Reduce the risk of further spread of ASF from premises associated with or near the infected premises.
- Prior to easing restrictions, conduct risk assessments, and prior to lifting restrictions, conduct surveillance for signs of additional disease.
- Comply with existing national laws as well as international trade obligations under the OIE disease control codes.

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Control strategy

The proposed control strategy divides the pig population of the Country in 3 different subpopulations –

- Infected zone (IZ) – 1 Km radius of infected premises (IP)
- Intermediate/ Surveillance zone (SZ) – 10 Km radius from the infected premises (9 km outside the IZ)
- Disease Free zone/ non-Infected area (FZ) – Area outside the SZ

14. Disinfection

Since many common disinfectants are ineffective, care should be taken to use a disinfectant specifically approved for the virus. Disinfection of equipment, vehicles, and personal protective equipment is essential when there has been exposure to an area with suspicion or confirmed diagnosis of ASF. ASFV is reportedly destroyed on some nonporous surfaces by sodium hypochlorite, citric acid (1%) and some iodine, and quaternary ammonium compounds.

15. During an outbreak

1. Infected and suspected infected animals must be placed under quarantine.
2. No movement of pigs or any products of pig origin should be allowed.
3. All infected and in-contact pigs must be humanely slaughtered.
4. Carcasses, animal products and bedding must be burnt or buried deeply on site.
5. Vehicles should be disinfected on entering and leaving farms.
6. Personnel should ensure that shoes, clothes and equipment are disinfected between farms.

16. Vaccines

There are no commercially accessible vaccinations at present. Over the past 40 years, several approaches have been employed in the development of an efficient vaccination against this condition, but the complexity of the virus and the host immune system's evasion by its numerous proteins make the creation of vaccines against ASF challenging. Lack of permanent cell lines that can support the ASFV's multiplicity and large-scale production is another barrier to its propagation. In a population, DNA vaccinations using ASFV genome constructs lacking CD2v, p54, and p30 provided only little protection.

Traditional vaccine preparation involves killing or inactivating the pathogen in various ways to render it non-virulent but immunogenic, resulting in the production of protective antibodies. However, because these vaccines do not activate killer T cells, they do not protect pigs against intact forms of ASFV. The use of live vaccines can increase T cell activation and antibody production without harming the inoculated animal. Both gene-deleted (genetically modifying the virulent forms of the virus by removal of sequences the code for lethal proteins) and naturally attenuated variants of ASFV fall under this classification.

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17. Biosafety and Biosecurity Measures

Implementing suitable import policies and biosecurity precautions are essential parts in minimizing an outbreak. ASF-free areas must be protected from the introduction of infected live pigs or pork products.

Biosafety at farm level is to be practiced. People or workers handling diseased pigs should follow all biosafety procedures, including using protective clothing such aprons, glasses, gloves, and gumboots, and avoiding going near other sheds. Gumboots should be cleaned with 2% sodium hydroxide right away after usage, and there are several commercial disinfectants on the market.

18. Eradication

Successful eradication is accomplished by rapid diagnosis, depopulation and proper disposal of all infected or in-contact swine on the infected premises. Disposal of carcasses will be necessary and must follow animal health official guidelines. Additionally, measures to ensure proper carcass disposal, sanitation/disinfection, movement controls and quarantines, and the prevention of contact with wild suids must be taken.

19. Public health risk

African swine fever virus does not cause disease in humans, so it is not a risk to human health.

20. Treatment

There is no treatment. Upon detection of the virus, all affected animals must be segregated and culled immediately.

21. Conclusion

ASF is a highly infectious disease of pigs and wild boars that results in 100% mortality and causes significant financial loss to pig producers. There is no commercially available vaccine. Pigs that have been exposed and are affected must be killed and buried underground. Restocking can begin four months after the diseased areas have been properly cleansed and disinfected. This should be done from known sources of healthy farms. The ASF has been reported from neighboring countries in India's north eastern states and can enter at any time and persist in our pigs. As a result, one must be attentive and alert.

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