**A case report**

**Gross and microscopic presentation of cysticercosis in a two-year-old boar in pig herd in Jos Plateau State Nigeria.**

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**Summary**

Background: Porcine cysticercosis is a neglected zoonotic caused by the larval stage of the tapeworm *Taenia solium* in pigs and humans. The infection has been well-thought-of as an exclusively economic problem, as cysticercosis impacts on animal production affecting food security due to downgrading and total condemnation of affected meat, or reduced sale price or confiscation of live animals and nutritional losses for small holder farming community thereby reducing income and rendering an important source of protein unsafe to eat leading to poor- quality pork. The aim of the study is to determine the cause of abnormal movement and confirm the presences of cyst in a two year old boar in Jos. On the 6th of March, 2016, a Veterinarian was invited to deworm a herd of 20 pigs supposedly raised under intensive management. Method: During physical examination, a 2-year-old boar in the herd was observed to show signs of exhaustion, gasping, unsteady gait and ataxia. Result: On close examination, the presence of cysts were noticed on the tongue. The animal was sacrificed for post mortem examination. Grossly, there was generalized multiple organ infestation involving the tongue, vertebral column, heart, masseter, biceps, diaphragm, meninges and the brain etc. Histopathologic examination of the affected organs showed irregularly round cyst approximately 200 µm in diameter. Conclusion: Porcine cysticercosis is present in a small holder pig farm in Jos metropolis. Unsanitary condition in the farm leading to occasional contact with human feces from the community could be the principal source of infection to the pigs. Community health education and improvements in hygiene are recommended as effective control measures to mitigate further spread of the disease.

**RUNNING TITLE: Cysticercosis in a two year old boar from a semi-intensive pig herd**

 ***Keywords****:* Cysticercosis, public health, husbandry, hygiene, necropsy, histopathology

**1. Introduction**

Cysticercosis is caused by the larval stage of the zoonotic tapeworm *Taenia solium* in pigs and humans (Johansen et al., 2017). The disease poses a serious socio-economic impact on poor rural pig farmers and is the significant cause of acquired preventable epilepsy in humans worldwide (Johansenet al., 2017). The disease has been designated as one of the 17 neglected tropical diseases (NTDs) affecting the poorest people in the world (WHO, 2015; Johansen et al., 2017). The infection has been well-thought-of as an exclusively economic problem, as it impacts on animal production. Cysticercosis affects food security due to downgrading and total condemnation of affected meat, or confiscation of live animals (Trevisanet al., 2017). These reduces income and renders it an important source of protein unsafe for consumption (Johansen et al., 2017; WHO, 2015).

**2. History**

**2.1 Case description**

In the spring of 2016 (6th March), a Veterinarian was invited by a pig farmer for the routine deworming of a herd of 20 pigs raised under a supposedly intensive system of management in buka –bakwai close to Federal Low-cost estate in Jos Plateau State, Nigeria. The family has a history of raising pigs for over 28 years and pigs were regularly dewormed with Ivermectin by Veterinarians. The farmer reported that he regularly slaughters his pigs at home without any form of meat inspection by veterinary or health authorities. He further reported that the pigs were served with both well and stream water and that although he had latrine, most family members defecate in the open bush especially during the farming season.

One of the pigs; a two-year-old boar was observed to show signs of exhaustion, gasping, ataxia unsteady gait with raised shoulders. Close systematic physical examination revealed the presence of multiple cysts on the sub-mucosal surface of the tongue, especially on the dorsal and ventral parts. The farmer was advised to sacrifice the boar for public health reasons. To enforce the condemnation, the boar was bought from the client by the Veterinarian for euthanasia and post mortem examination.

**2.2 Post mortem and histopathological findings**

The animal was humanely sacrificed and post mortem examination was conducted. The affected tissues were harvested, fixed in 10 percent buffered formaldehyde and processed at the Central Diagnostic Division, NVRI Vom. Five µm paraffin-wax sections of organs were dewaxed and stained with hematoxylin-eosin (Titford , 2009). The processed tissues were mounted on charged microscope slides and observed under a Carl Zeiss light microscope for histopathological changes.

**2.3 Gross pathological** findings reveals generalized systemic multiple organ parasitosis involving the tongue, heart, vertebral column, pericardium, myocardium, skeletal muscles (masseter, biceps, intercostal, diaphragm and abdominal muscles), meninges, brain, kidneys, lymph nodes, liver, lungs, and spleen (Figure 1-2).

**2.4 4 Histopathology**

Histopathologically, the affected organ showed irregularly round cestode parasite cyst up to 200 µm in diameter. The cysts are composed of an outer cuticle, a cellular layer and an inner loose layer with a marginated scolex (cephalic), sucker and hooklets (Figure 3- 4) which is consistent with cysticercus larva. In some instances, the cysts in the organs were calcified.

**2.5 Stool examination of the client**
Stool samples were collected from eight family members of the client and examined in the laboratory of parasitology at the National Veterinary Research Institute Vom Plateau State Nigeria by the formal ether sedimentation technique. No parasite egg was found in all the examined stool samples.

**2.6 Management of pigs**

The remaining pigs were dewormed with Ivermectin injection 1% (Ivomec injection Merial Canada) subcutaneously at a recommended dose of 300µg mcg /kg body weight.

**3. Discussion**

This report is typical of a severe generalized form of cysticercosis which is usually encountered by farmers during home slaughter but rarely reported to the appropriate authorities for fear of the meat being confiscated. Such practice is common among pig farmers resulting in the under reporting and hence reduction in the true prevalence of the disease (Weka , 2020). Despite the long history of raising pigs, the farmer did not detect the signs of the disease in the boar until the visitation of the veterinarian, which underscores the importance of engaging the services of professionals in pig farming. The clinical signs of exhaustion, gasping, unsteady gait, ataxia, raised shoulders manifested by the two-year-old boar corroborates the severity of the lesions and multiple organ involvement as reported in other studies (Mkupasi et al., 2014; Trevisan et al., 2016). They reported that on few occasions they had noticed signs of gasping, unsteady gait and ataxia in some of their pigs previously sold or eaten but had never attributed it to anything significant.
 This is the first study reporting such clinical manifestation in pigs in Nigeria. Several of such animals are slaughtered by their owners at home without any form of meat inspection by veterinary or health authorities and find their way to the market where they are sold to unsuspecting consumers exposing members of the public to the risk of cysticercosis (Weka et al., 2019). Although existing legislation in many African countries necessitates that cysticercotic pig carcasses be confiscated and condemned at meat inspection, this does not usually occur, rather, infected pig carcasses are sold to consumers at reduced prices (Weka, et al., 2019; Ngowi et al., 2013), which promotes spread of infection and further pushes the burden of disease onto the poor, who cannot pay the premium for safe meat.

The farmer informed us that a common practice in the community is for a farmer to slaughter a pig at home, share the meat with neighbors and sell part of it to interested consumers in the neighborhood. He claimed ignorance of the disease called porcine cysticercosis but described having occasionally seen cyst-like structures in slaughtered pigs which is referred to as dawa (grain) in the local vernacular (Hausa). He admitted that although they did not know the health implications of consuming pork infected with the grain-like structures, they normally trim them off and either bury or throw them into the refuse dump. Therefore, it was not their practice to condemn any cyst infested pig. However, ignorance and socio-economic factors would have prevailed against reason and the meat from such animal could have ended on the family’s table not minding the health implications. Cysticercosis is being well-thought-out as a poverty-perpetuating condition with adverse economic consequences affecting populations in low-income countries, where unhygienic conditions prevail (WHO, 2015).

Although, history revealed that the pigs were regularly dewormed with ivermectin, one of them was still severely affected. It has been reported that ivermectin was not very effective against the larval cestode (Mkupasi et al., 2013), because it does not have gamma aminobutyric acid (GABA) system which ivermectin utilizes biochemically (Barragry, 1987).

The household members use well water for domestic and drinking purposes, while the pigs were served with both well and stream water. Although the household that owned the infected pig has a latrine, most family members defecate in the open bush especially during the farming season. More so, several houses in the study area lacked latrines and commonly practice open defecation. Furthermore, the community lacked basic amenities and infrastructures including pipe borne water and utilizes water from the nearby streams for domestic purposes. The family members do not deworm themselves. Even though they admitted to have heard about tapeworm infection in humans they are not aware of the life cycle of tapeworm and its association with pigs.

Though the piggery under discussion is meant to be an intensively managed backyard farm, the pigs usually escapes through an un-mended broken down part of the enclosure thereby gaining access to the filthy environments to wallow in the nearby stream and scavenge for food from nearby refuse dumps. The presence of a stream and water bodies near to the piggery where people come to do their domestic chores and also defecate in the process provides a conducive environment for the perpetuation of the life cycle of *T*. *solium* thereby constituting a threat to public health. Humans are the sole definitive host and carrier of the adult tapeworm and they release the gravid tapeworm segments along with feces in the environment (Johansen *et al*., 2017; WHO, 2015). Thus open defecation, poor personal hygiene and low environmental sanitation are risk factors to cysticercosis in rural or peri urban areas, where semi intensive or extensive husbandry is practiced and where toilets are lacking (Weka et al., 2019; Weka , 2020). The human fecal samples analyzed in this farm were negative for *Taenia* spp. eggs. Although stool microscopy has been used to detect the presence of the eggs and adult *T. solium*, it has poor sensitivity and misses 60 - 70% of cases (Mayta, 2000). Therefore, results of stool microscopy should be interpreted with caution.

The farmer was advised to subsequently slaughter his pigs in the government abattoir where meat inspection will be conducted to ensure safety of consumers. Furthermore, the broken fence of the piggery should be repaired. The household members were advised to observe strict personal hygiene and ensure meat is thoroughly cooked before consumption.

**4. Conclusion**

The breakage in the wall provided outlet for the pig to have access to the infected human stool.

The farmer and his household are totally ignorant of the disease and have never had their pork inspected. The disease thrives in endemic areas where ignorance and superstitious beliefs including lack of information about its significance and meat inspection is inadequate or absent, and amenities for safe meal preparation are inadequate (Lightowlers et al , 2016; Weka et al*.,* 2019). Moreover *T. solium* are associated with increased risk of disease transmission in stakeholders who may know about tapeworm infections in humans but are unable to relate them to porcine cysticercosis (Thys et al., 2015; Edia-Asuke et al., 2014).  Although existing legislation in many African countries requires that cysticercotic pig carcasses be condemned at meat inspection, this does not usually occur, rather, infected pig carcasses are sold to consumers at reduced prices (Weka, et al., 2019), which promotes spread of infection and further pushes the burden of disease onto the poor, who cannot pay the premium for safe meat. The farmer in this study and his family normally consumes the pork even when infected with cyst without condemnation.

**Competing Interests**

Authors have declared that no competing interests exist.

**Ethical Approval**

Ethical clearance was obtained from the ethical / research and publication committee of the national veterinary research institute, vom, Plateau State Nigeria number: AEC**/03/25/16**

**Competing Interests**

Authors have declared that no competing interests exist.

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