

## ***Taenia solium* Prevalence in Nepal: A Retrospective Review**

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### **ABSTRACT**

*Taenia solium* is a zoonotic cestode parasite which causes cysticercosis in human and porcine cysticercosis in pigs. The infective stage of *T. solium* develops in pig while that of *T. saginata* develop in cattle and buffalo. The adult stages of *T. solium* are obligatory intestinal parasites for man. In humans the cysticercus larvae commonly encyst in the brain, causing neurocysticercosis. The disease was first described in pig by Aristophanes and Aristotle in 3<sup>rd</sup> century B.C. In Nepal, *Taenia* cysts were observed for first time in pork meat slaughtered in Kangeswari, Kathmandu more than 30 years ago. *T. solium* is the cause of 30% of epilepsy cases in many endemic areas where people and roaming pigs live in close proximity. More than 50 million of the world's populations are infected worldwide and 50000 die from Neurocysticercosis yearly. In Nepal, the prevalence ranges from 0.002-0.1% in general population. Accurate diagnosis required detailed post mortem examination involving slicing of affected tissue to determine the viability of cysts. Cysticerci occur most commonly in striated muscles tissues and brain of pigs. The application of vaccination with TSOL18 recombinant vaccine along with oral medication of oxfendazole can reduces the transmission by pigs whereas use of niclosamide is found effective in humans. Hence the use of medication eventually reduces the incidence of neurocysticercosis in human and porcine cysticercosis in pigs.

**Keywords:** Cysticercosis, Pigs, Prevalence, *Taenia solium*

### **INTRODUCTION**

*Taenia solium* is a cestode parasite of zoonotic importance which causes cysticercosis in human and porcine cysticercosis in pigs. It is a food-borne infection which is emerging as a major health problem world wide (Sciutto *et.al.*, 2000) . The infective stage of *T. solium* develops in pig while that of *T. saginata* develops in cattle and buffalo. The infection is endemic in the area where pigs are reared under scavenging system with poor sanitation, open defecation and uncontrolled slaughter of infected pig. It is endemic in the developing countries of Latin America, Africa and Asia (Coral-Almeida *et.al.*, 2015). WHO has considered neurocysticercosis (NCC) as the most important neurologic disease in humans (Scheel *et.al.*, 2005). About 50 million people of world are infected and among them 50000 die from NCC yearly (Scheel *et.al.*, 2005). Neurocysticercosis is one of the major causes of onset of symptomatic epilepsy in the areas where pork tapeworm *T. solium* is endemic. The cysticercosis caused by *T. solium* is considered as neglected tropical disease by WHO (2015). Various control measures are operated nowadays for successful in reducing the incidence of parasite. Vaccination using TSLO18 recombinant vaccine along with oral treatment of oxfendazole @ 30 mg per kg is found to be effective (Poudel *et.al.*, 2019). The main aim of this paper is to know the status of *T. solium* by

reviewing various articles through PubMed, Google scholars and research gate. The overall prevalence of *Taenia solium* in Nepal was determined along with its public health significance and proper suggestion was given to control its prevalence through rational use of vaccination and medication in both animals as well as in humans.

## **DISTRIBUTION AND EPIDEMIOLOGY**

*Taenia solium* is distributed throughout the world and is particularly prevalent in the areas where small scale pig farming or pigs as household livestock is common (García *et.al.*, 2003). Therefore, the developing countries such as Latin America, Africa, and Asia are considered as endemic areas for tapeworm. Until recent years, there were only sporadic cases in the United States. However, due to increased immigration from Central America and travel to endemic areas, cysticercosis is on the rise in the United States, especially in California, Arizona, New Mexico, Texas, and Colorado. Different forms of the disease occur in different areas depending on type and location of infection, including autoinfection or by the fecal-oral pathway. The disease cysticercosis in pigs was first discovered by Aristophanes and Aristotle during 3<sup>rd</sup> century B.C. (Cook, 1988). Although accurate information on prevalence rates is rarely available, the disease is known to be endemic in all continents with the exception of Australasia. Exceptionally high prevalence rate occurs in Latin America from Mexico to Chile. In Mexico City 1.4-3.6% of autopsies in general population provide evidence of cysticercosis (Cook, 1988). The disease spreads sporadically throughout the Europe and it is also prevalent in India, Pakistan, Indonesia, Thailand and northern China.

In Nepal, *Taenia* cyst were first observed more than thirty years ago in the pork meat slaughtered in Kangeswari, Kathmandu (Joshi *et.al.*, 2007). Neurocysticercosis was reported in Nepal during December, 1997 along with its mode of infection (Joshi *et.al.*, 2007). Del Brutto *et.al.*, reported that neurocysticercosis is a common cause of epilepsy among the Nepalese soldiers stationed with British Army in Hong Kong. The available data suggest that the prevalence ranges from 0.002 -0.1 % in general population in Nepal (Bista, 2006).

## **LIFECYCLE**

The completion for the lifecycle of *T. solium* requires two hosts, man as definitive host and pigs as intermediate host. Pigs harbour the infection due to consumption of vegetation contaminated by the parasite's eggs or gravid proglottids. The parasites then mature to oncospheres (embryos) in the pig's intestine, which break the intestinal wall and develop into infective cysticerci (larvae) in the muscles. Infection is spread to humans when they eat raw or undercooked, infected pork meat contacting infective cysticerci larva. The larva migrates to small intestine which then matures to adult tapeworm resulting to cause taeniasis. After the parasitic larval lodges in the brain, it causes neurocysticercosis. Completion of life cycle of the parasite has been prevented in many developed countries through improvements in sanitation and hygienic practices in pig rearing, which eventually prevent the animals from being exposed to human faeces. The prevention of completion of lifecycle can facilitate in reducing the prevalence as well as prevent human from exposure to disease. The presence of suitable environment for the completion of lifecycle can be one of the causes of prevalence of this parasite in the nation.

## CURRENT SITUATION IN NEPAL

Various researches are carried out in Nepal regarding to the prevalence of *T. solium* Nepal and among them very few authentic research articles have been published till date. The published and unpublished data suggests that the disease has been established in the country, and is developing a serious public health problem.

Joshi (1973 and 1991) observed *Taenia cysts* in pig meat slaughtered in Kangeswari, Kathmandu for the first time more than 30 years ago. Likewise, (Bajaj, Satish K. 1997) reported about the cysticercosis and its mode of infection. Different intervention programmes are carried out in order to control its transmission. The applied intervention consists of intensive combination of mass human tapeworm deworming with niclosamide along with pig anthelmintic treatment with oxfendazole and pig immunization with the TSOL18 vaccine, in various rounds for approximately one year (Poudel *et.al.*, 2019). In Nepal, generally poor and marginalized people are prone to infection due to close contact with pigs, poor sanitation.

Table 1: Prevalence of *T. solium* in pigs of Nepal

District	No. of tested animals	Percentage of positive animals	Reference
Banke	110	32 (29%)	(Sah <i>et.al.</i> , 2017)
Syangja	180	77 (43%)	(Maharjan and Gaihre, 2010)
Tanahun	152	28 (18%)	(Joshi <i>et.al.</i> , 2004)
Kathmandu	196	28 (14%)	(Devleesschauwer <i>et.al.</i> , 2013)
Dharan	54	6 (11%)	(Joshi <i>et.al.</i> , 2004)

## TAENIASIS IN HUMAN

*T. solium* causes two diseases when they infect the human: taeniasis and cysticercosis. Taeniasis is caused by infection of the adult tapeworm in the intestines of humans and is most often acquired by eating uncooked or poorly cooked infected pork meat. Cysticercosis causes a significant public health disorder when humans ingest parasite eggs, which liberate larvae that may settle in the nervous system, causing a serious condition called neurocysticercosis (NCC) (Carabin *et.al.*, 2017).

Cysticercosis (CC) and neurocysticercosis (NCC) are characterized by development of cyst in the eyes, skeletal muscle, heart, or brain caused due to the ingestion of *Taenia solium* eggs. Symptoms can vary from the clinically mild to severe, in which epileptic seizures, hydrocephalus, or localized neural deficits predate *T. solium* associated fatalities. Over 20 million people in the world are estimated to be infected with either the larvae or the adult tapeworm and its wide-ranging medical, economic and social effects are felt globally (Pawlowski *et.al.*, 2005). In 2015, the WHO Foodborne disease burden Epidemiology Reference Group identified *T. solium* as a leading cause of deaths from food-borne diseases, resulting in a considerable total of 2.8 million disability-adjusted life-years (DALYs) (Jansen *et.al.*, 2018).

Neurocysticercosis is considered as one of the main causes of epilepsy in the developing countries of Asia, Latin America, and Africa (Pal *et.al.*, 2000). In Nepal, human

neurocysticercosis is a frequently diagnosed condition where it had been estimated to be responsible for the highest burden of disease caused by a parasitic zoonosis (Devleeschauwer *et.al.*, 2012). The cases of neurocysticercosis are reported from many hospitals of Kathmandu (Amatya and Kimula, 1999). Sixty two patients with cysticercosis were confirmed out of 23,402 biopsy cases detected at Patan hospital, Lalitpur. During the past five years, records from Bir Hospital, and Kanti Children's Hospital reported 4 and 11 cysticercosis cases in Kathmandu, respectively (Joshi *et.al.*, 2004). The main cause of epileptic seizure is now considered as neurocysticercosis which accounts for 50% of the patient with partial seizures (Rajshekhar *et.al.*, 2003). About 50 million people are infected worldwide and among them 50000 die from NCC yearly (Scheel *et.al.*, 2005).

## **DIAGNOSIS**

For the proper diagnosis of *T. solium* cyst in pork meat, the pig should be slaughtered, viscera should be separated and heart, liver, brain as well as half the body skeletal musculature should be sliced using hand knives in order to determine the viability of cysts. If one or more viable or non-viable cysticerci were found in the muscle and or the brain, the pig should be confirmed of porcine cysticercosis (Poudel *et.al.*, 2019). The case of taeniasis can also be confirmed by findings eggs or gravid proglottids in direct fecal smear. Palpation of the whole body for the presence of subcutaneous and intramuscular nodules along with neuroimaging techniques such as CT scan and MRI can also be done for diagnostic approaches in humans (Scheel *et.al.*, 2005).

## **TREATMENT**

Treatment of taeniasis is a good option due to direct causal link between taeniasis and human cysticercosis. For the proper treatment of taeniasis, pig should be vaccinated with 1ml Tsol18 vaccine (150µg TSOL18 recombinant protein in mineral oil adjuvant; Cysvax, Indian Immunological Limited, India) through intramuscular route (Flisser *et.al.*, 2004). Along with this intensive combination of mass human tapeworm deworming with niclosamide @ 2g as a single dose for adults along with pig anthelmintic treatment with oxfendazole @30 mg per kg body weight (Paranthic 10%, MCI, Morocco) is found to be effective (Poudel *et.al.*, 2019).

## **PREVENTION AND CONTROL**

To improve *T. solium* control, we must train meat producers sellers in the safe handling of meat. Slaughtering of pigs in open space should be prohibited. The meat should be properly inspected by meat inspector before selling to market. Pig should be reared separately away from human settlement which reduces the contamination between human and pig. People must consume well-cooked as well as refrigerated meat. Sanitation and pig husbandry around the house should be properly maintained. The pigs should be immunized to control the transmission of disease. Regular and active surveillance should be done to know the prevalence and incidence of taeniasis and cysticercosis in both definitive and intermediate hosts.

## DISCUSSION

The prevalence of *T.solium* in Nepal is found to be significantly different according to different research conducted at different region. The highest prevalence of procine cysticercosis was recorded in Syangja district where 77 out of 180 animals were found to have cysticercosis (Maharjan and Gaihre, 2010). The lowest prevalence was recorded from Dharan district where 6 out of 54 (11%) animals were found to have cysticercosis (Joshi *et.al.*, 2004). In Banke district 32 out of 110 (29%) animals were identified with *T.soliumcysticerici* (Sah *et.al.*, 2017) whereas in Kathmandu 28 out of 196 (14%) (Devleesschauwer *et.al.*, 2013) were found to be infected. Likewise, in Tanahun 28 out of 152 (18%) were found to harbour cysticercosis. These data are based on the detailed post mortem examination of carcass. These data suggest that the prevalence of cysticercosis is emerging day by day in Nepal. This is mainly due to poor sanitation, unhygienic management, close contact between pigs and animal, open defecation by humans, consumption of raw or poorly cooked pork meat. It is due to unhealthy rearing practices, where pigs are allowed to feed on human feces, lack of latrines, poor hygiene habits, and lack of meat inspection, has contributed to the prevalence of the disease. The people of terai are found rearing pig under scavenging system which initiates the cause of disease due to free roaming of animals; they transmit disease from one place to another.

The high prevalence in Syangja might be due to high number of pork consuming community such as magar, dalits etc. who rear pigs under free roaming system with poor sanitary methods (Maharjan and Gaihre, 2010). Moreover, lack of education, poor hygiene and low socio economic status may lead to its prevalence in high number.

The prevalence of porcine cysticercosis in pigs from the Banke District of Nepal indicates that there is a high rate of *T. solium* transmission in the region and, very likely to have a high rate of human cysticercosis (Poudel *et.al.*, 2019). The unhealthy pork rearing practices, open defecation, poor hygienic habits have contributed to the establishment and transmission of the disease in human as well. The high incidence in human may due to improper eating habits of pork meat in the form of barbeque.

The reduction of prevalence of procine cysticercosis can be done by combined use of vaccine Tsol18 and administration of oxfendazole @30mg/kg body weight (Poudel *et.al.*, 2019).The combined use provides both treatment as well as prevention from subsequent infection. The drug oxfendazole helps in reduction of cysticerici whereas vaccine protects from being exposure to cysticercosis.

## CONCLUSION

The review of prevalence taeniasis and cysticercosis research in Nepal showed that parasitic infections have existed for many years. The zoonotic parasite is deeply rooted in the nation which is found unnoticed due to lack of sufficient research. If this condition goes one then it will develop hazardous problem in both human as well as pig. The available data and reported cases suggest that the disease is found to be endemic in the nation which is developing into serious public health problem. Many communities who rear pig for subsistence use are unaware of

zoonotic disease, proper sanitation and hygienic practices. Provision of public awareness should be conducted in those communities. Timely use of vaccination and medication will support for the reduction of incidence in both human as well as pigs.

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## Author's Contribution

BKC reviewed the literature. KK provided guidance and logistic support to collect the articles. Those data were presented systematically and discussed about the reason behind the prevalence in Nepal.

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