Case Analysis of Leptospirosis in Pituruh and Purwodadi, Purworejo District, Central Java Province, Indonesia 2019

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Abstract

Background: Leptospirosis has been an outbreak in Purworejo since 2005 with 4 cases and 100% Case Fatality Rate (CFR). In the last years, 2 cases of this disease with 50% CFR was reported in 2018 and another 10 from January until April 2019. Aims: This paper described species of rats, examined Leptospira bacteria on their kidneys and water, analyzed risk and supporting factors of high leptospirosis fatality. Methods and Material: This was a descriptive study with cross sectional design, and the activity was held in Pituruh and Purwodadi, Purworejo District, Central Java Province, Indonesia on May 13-16th, 2019. Rats trapping used single live traps, while environmental survey and interview was conducted for the dead leptospirosis patients' family. Furthermore, the kidneys of these animals and water samples from environment were examined by Polymerase Chain Reaction (PCR). Statistical analysis used: descriptive analysis. Results: All of the trapped rats were Rattus tanezumi and the shrew Suncus murinus at success rate of 7% and 9% respectively in Pituruh and Purwodadi. One out of 21 R. tanezumi was Leptospira infected, and all of the tested water samples were negative. Risk factors include flooding and occupation related to farming, while delay in the diagnosis of leptospirosis had impact on higher CFR. Conclusions: Promoting early diagnosis and medical test for leptospira are necessary in the Public Health Center, especially in flood areas to anticipate fatality of the disease.

Keywords: leptospirosis, cases, case fatality rate, rats , Purworejo

Key Messages:

The high case fatality rate of leptospirosis in Purworejo District needs attention about the importance of promoting leptospirosis to health workers and the community. There is need for early detection and warning, together with availability of leptospirosis diagnostic tools at first-level health facilities to
anticipate more severe symptoms, especially in flooding areas and communities with risk factors such as farming.


Introduction

Leptospirosis is an infectious disease that has death risk, caused by the Leptospira bacteria. The main reservoir for leptospirosis is rodents, especially rats which are the maintenance hosts of Leptospira. The bacteria are preserved in the liver and kidneys of rats throughout their life and are excreted in large amounts of urine. Leptospira is not harmful to the reservoir but tend to be deadly when present in humans.

Leptospirosis in Indonesia for 2011 - 2018 showed a peak point in 2011, 2013, 2016 and 2018 with the highest Case Fatality Rate/CFR in 2012, 2015 and 2017. In 2018, there were 894 cases with 148 deaths (CFR 16.5 %) and the highest was reported from Central Java. Leptospirosis in Central Java from 2015 - 2018 have increased starting from 149, 164, 316 to 427 cases respectively. The highest cases and fatality due to leptospirosis in 2018 occurred in this region with 20.84% CFR.

Leptospirosis became an outbreak in Purworejo District in 2005 with 4 cases and 100% CFR. In 2007, only 1 case was reported and it was zero in the following 3 years. In 2011, there were 25 cases, but after several years none was reported, then there were 12 leptospirosis cases with the youngest patient aged 14 years old in 2016, and in 2017 there were 10, all without death record. In 2018, 2 cases were reported with 1 death (50% CFR), and in 2019 there were 10 with 6 deaths (60% CFR) until April 2019.

To anticipate the increase of the cases with higher CFR and to confirm leptospirosis transmission, it is necessary to conduct a rat and environmental survey, as well as interview to family of the infected persons that died in Pituruh and Purwodadi, Purworejo District. The objectives of this activity were to identify the species of rats and shrews that were trapped, measure the trap success rate, detect the presence of Leptospira in the two animal categories and water found in the patient's environment, analyze risk and supporting factors for leptospirosis fatality.

Methods and Material

The activity was descriptive with a cross sectional survey design that was carried out on May 13-16th 2019. Rat trapping, environmental surveys and interviews to family of the dead leptospirosis patients were held in Pituruh and Purwodadi, Purworejo District, Central Java Province, Indonesia. The location selection was based on reports from the hospital, about presence of the dead leptospirosis patients.

Samples consist of all captured rats' kidneys and water in the environment where transmission was possible from the interview results, and were collected by purposive sampling. Rat trapping with single live traps using grilled coconut bait or salted fish, totaling around 150 pieces installed in the patients' house for one night. The rats trapped were anaesthetized with ketamine HCL 100 mg / kg
body weight. These animals were also identified with rat identification key,\textsuperscript{6,7} while the samples were examined for the presence of Leptospira bacteria using PCR method. Interviews were used to determine the disease, medical history and risk factor of leptospirosis in 1 and 2 persons in Purwodadi and Pituruh Sub Districts respectively.

**Results**

1. **Rats trapping**

   The number of rats trapped in Pituruh was as many as 10 which were all *Rattus tanezumi* species from 150 traps installed (7% success rate). The results of the rat survey in Purwodadi conducted overnight had 12 rats from 136 traps installed (9% success rate) consisting of 1 *Suncus murinus* and 11 *R. tanezumi*. The rats trapping results are shown in Figure 1.

2. **Interview**

   Interview showed that the jobs of all the patients that had risk of leptospirosis was related with farming. The other risk factors for the transmission of this disease include those related to flooding (at home or place of work), injury on the feet by snails in the farm, contact with puddle and well water, and not using personal protective equipment (PPE).

   History showed that the initial treatment of leptospirosis was by a medical practitioner or taking drugs from a shop. The whole patients experienced delays in early clinical detection of

**Figure 1. Rats trapping in Purworejo District**

The results of Polymerase Chain Reaction on the rats and shrew kidney samples showed one male *R. tanezumi* in Pituruh was Leptospira infected (prevalence 4.76%). The positive rat was trapped at the neighbour’s house of the leptospirosis patients that died in a distance between 9m (metres).
leptospirosis, thus the patients came to the hospital too late and were in an advanced stage already (all appeared icteric), which lead to not getting antibiotics on time.

3. Environmental Survey

During dry season, environmental survey was carried out to ensure there were no puddles filled with water around the patient’s environment, but cases generally occurred when it was rainy or after flooding either on the farm or at home. The results of the activity were obtained using six (6) water samples from the home and rice fields, and the PCR method showed that all of them were Leptospira negative.

All of leptospirosis patients that died have environment close to the Bogowonto river or irrigation canals. The condition of the houses or rice fields was nearness to animals / livestock such as cows, goats and dogs. In fact, at one of the rat trapping locations, there were many dogs roaming around. This condition made it possible for the transmission of Leptospira bacteria from livestock to human through their wastes.

Figure 2. Environmental survey on leptospirosis cases who died in Pituruh and Purwodadi

Observations on the environment’s condition are that the houses were in a humid condition ranging from 52-69% and relatively dark. There was a part of the homes that had soil floors, while the location of the infective items was irregular. There was presence of garbage with uncovered containers that were not discarded daily, open waste disposal and the houses were not rats proof.
Discussion

The success rate of rats trapping in Purworejo Regency was about 7-9%, indicating that it is still in relatively normal condition. The population density of rat species fluctuates depending on environmental conditions, thus influencing transmission of the pathogens they carry. The trapped rats were *R. tanezumi*, because of their wide habitats that ranged from primary and secondary forest, tropical rainforest, plantations, office buildings to rural and residential areas or at an altitude of 0-2000 m. *Rattus tanezumi* is mostly found indoors and it is a subspecies of *Rattus-rattus* which is common in people's homes on Java island. The movement of rats between houses to survive and breed tends to also be one of the causes of wider spread of leptospirosis.

In this study, the prevalence of Leptospira bacteria in rat found in Purworejo was 4.76% which is low, the same as the results of the 2015 special study on Vector and Disease Reservoir in Purworejo. The results of PCR examinations on 71 rats from three (3) ecosystems (forest, non-forest and coastal) showed Leptospira infection in *R. tanezumi* (1 rat’s head) and *R. tiomanicus* (3 heads). The prevalence of Leptospira bacteria in *R. tanezumi* in this region is similar to that of *R. norvegicus* in Maumere City which was 4.4%. Rats are the main reservoir for leptospirosis because they are able to excrete Leptospira bacteria in a long time and have high concentrations in their urine without clinical symptoms. Many of the findings of leptospirosis was in rats found in urban or rural areas around human settlements, even though the Leptospira positive animals is also detectable in distant places such as forests. Cosson states that the genus Rattus and Bandicota are the most important hosts for leptospirosis. Transmission between rats occurs both in ecosystems close to and far from settlements. The study in three (3) districts in Central Sulawesi Province showed that *Rattus sp* was positive for Lesptospira bacteria in primary, secondary, and coastal forest habitats, settlements, yards, gardens, rice fields, beaches, and fields.

Leptospira bacteria were not found in the water samples, possibly because this study was carried out during dry season. Therefore, it was less supportive to Leptospira transmission in the rats population, due to the fact that water plays an important role in the transmission of these bacteria. Dry air, hot sunshine and an inappropriate pH make up an unfavorable atmosphere for the life of Leptospira. The prevalence of these bacteria in rats is influenced by several factors, including type of environment (habitat and altitude) and sex. The swimming ability of reservoir animals and minimum temperature is also associated with leptospirosis infection.

The presence of Leptospira positive rats often contaminates the soil, environment, humans and livestock around them. There was an outbreak of leptospirosis in Sleman, Bantul and Kulon Progo several years ago. In a study conducted on the Progo River throughout these two districts (Sleman and Kulon Progo) in Yogyakarta, the risk of leptospirosis on cows with 1-5 tails of rats was 2.67 times compared to those that were rat-free. Stables with a waste disposal distance of <5 m allow cattle to develop leptospirosis 2.09 times. As many as 43 of the 330 (13%) cows in the area were positive for the disease as confirmed by Microscopic Agglutination Test/MAT, although most (79.6%) of them were not washed into the river and drank from well water (59.1%). Majority of the cows were infected with leptospira serovar *hardjo* (38%), 18% *rachmati*, 15% *ichterohaemorrhagiae*, 9% *brickviae*, 7%
The prevalence of leptospirosis on sheep in Kulon Progo was 3.33% with *icterohaemorrhagiae* serovar.\textsuperscript{15}

The existence of *R. tanezumi* that was infected by *Leptospira* in this study proved that *R. diardi*/ *R. tanezumi*, *R. norvegicus*, and *R. exulans* as well as *Suncus murinus* were the most common species that often become a reservoir for leptospirosis.\textsuperscript{16} Himsel stated that mice infected with the *Leptospira* bacteria near settlements have the potential to transmit the bacteria to humans around them when there is poor environmental sanitation, littering and improper food storage. But, Aulia study proved that clean and healthy living habits of the people are important in the household, where sewer conditions, the presence of rats, stagnant water, facilities of waste and garbage disposal have correlated with the incidence of leptospirosis in humans.\textsuperscript{13}

The leptospirosis patients that died in this study lived close to the rivers / irrigation. Furthermore, areas close to the rivers are more likely to be exposed to overflow during floods in the rainy season. Irrigation canals are suitable places for the growth of *Leptospira* bacteria, while the people that live close to dirty drains have 5.15 greater risk of suffering from leptospirosis.\textsuperscript{17} Cases of leptospirosis at the borders of Bantul, Sleman and Kulon Progo show groupings based on the distance of the houses of those infected from rice fields, rivers and roads according to the pattern of planting and early rainy season which tends to increase yearly. This needs to be a concern to ensure that it is able to anticipate an increase in leptospirosis cases in the following years.

In March 2019 there were floods in 4 sub-districts in Purworejo District, which were Bagelen, Purwodadi, Ngombol and Bayan\textsuperscript{18}, while another happened in other sub-districts on the previous January. Also, floods occurred due to the overflowing of the Kaliwawar and Bogowonto rivers which experienced high sedimentation.\textsuperscript{19} Leptospirosis outbreaks often follow floods, storms or other disasters in the tropical countries. The incidence of leptospirosis in tropical countries is higher than in subtropical and cold climates.\textsuperscript{20} Leptospirosis associated with this flood occurred in many areas including Cengkareng Sub District, West Jakarta, and 26 cases were reported with 15.3% CFR.\textsuperscript{21} There is possibility that *Leptospira* bacteria comes from livestock found around the leptospirosis cases. Sources of this disease’s transmission in animals include rats, pigs, cows, goats, sheep, horses, dogs, cats, insects, birds, insectivores (hedgehogs, bats, squirrels) and foxes which tend to become *Leptospira* careers. Bacteria are transmitted to other animals directly or indirectly through urine or other body fluids containing *Leptospira*. The results of study in Demak showed that livestock such as goats, sheep, cats and cows tested positive for the bacteria by PCR examination.\textsuperscript{22}

The results of Ramadhani’s study showed that the presence of puddle water that contaminated with rat or pet urine facilitates the entry of *Leptospira* bacteria into the human body due to direct or indirect contact with rats or intermediate hosts.\textsuperscript{23} These bacteria enter the human body through injured skin / blisters, especially around the feet, mucous membranes on the eye, nose, and of the mouth.\textsuperscript{24} *Leptospira spp* are able to persist in moist soil and natural water bodies despite cold and nutrient-poor acidic conditions, but do not survive in dry condition.\textsuperscript{1}

Leptospirosis control in Purworejo District and generally, encountered the same obstacles in this course. Most of the leptospirosis patients come for health services in a delayed state. Commonly,
the patients and their families do not know whether the symptoms they feel before are leptospirosis and capable to endanger their lives.\textsuperscript{25}

The patients that died in the course of this study were not detected as leptospirosis positive from the onset. The atypical early symptoms of the disease make many health workers forget to diagnose leptospirosis and this supports the associated high fatality rate.\textsuperscript{26} Approximately 10-15\% of leptospirosis fatality was due to pulmonary hemorrhage, arrhythmia, renal and heart failure due to myocarditis. In the study on leptospirosis cases in Bantul District for 5 years, there were 32 of 128 patients that died (CFR 25\%), which showed that those with shortness of breath, headache, myalgia, jaundice and thrombocytopenia had 82.12\% probability of experiencing death.\textsuperscript{26} Mild leptospirosis was estimated as 90\% of all cases of the disease with symptoms of fever, headache and myalgia and only 10\% severe leptospirosis with renal failure, jaundice and bleeding.\textsuperscript{16}

The study in Bantul suggested giving antibiotics in all phases, both acute (fever) and severe leptospirosis. There is need for supportive therapy with attention to fluid and electrolyte balance in severe leptospirosis. Cases with renal failure were treated for hemodialysis and it is recommended that early transfusion of platelets be performed when these blood cells are less than 50,000 / mm\textsuperscript{3} or drop drastically in a relatively fast time.\textsuperscript{26}

In 2019, the high Case Fatality Rate of leptospirosis in Purworejo District needs attention about the importance of promoting leptospirosis to health workers and the community. There is need for early detection and warning, together with availability of leptospirosis diagnostic tools at first-level health facilities to anticipate more severe symptoms, especially in flooding areas and communities with risk factors such as farming. Attention to leptospirosis is expected to reduce the fatality rate, which is observable from the number of cases that are six (6) without death record in Purworejo as at June 2020.\textsuperscript{27}

Transmission of diseases through rats needs to be watched out because these animals are able to adapt to various types of climates, extreme conditions and have a wide space for movement both in residential and swampy areas, markets, grasslands, gardens and forest edges. The importance of rodent-borne disease surveillance in Purworejo is not only about leptospirosis but also including another type of infection, because the results of other studies found that 8 of 57 \textit{R. tanezumi} were hanta virus positive as detected by serology.\textsuperscript{28}

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\textbf{Conflict of Interest}

The authors have no conflict of interest associated with the material presented in this paper.

\textbf{References}


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