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Leptospirosis: A Review of the Silent Threat in West Africa

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Abstract

Leptospirosis is a neglected tropical zoonotic disease of public health importance causing significant mortalities among animals and humans. Due to negligence, rapid, unplanned urbanization, and poor sanitation, leptospirosis emerges as a leading cause of acute febrile illness in many developing countries. Yet, an understanding of the epidemiology of leptospirosis in animals remains a knot to untie hence more scientific evidence is required on the disease epidemiology. The literature search was conducted to select and compile peer-reviewed journals, book chapters, and international organization proceedings on the epidemiology, control, and impacts of leptospirosis. In the majority of the cases reported, the infections are asymptomatic. Although recreational exposure is also known to occur, occupational exposure to rodents and other animals is the primary method of transmission. Those who are at risk include healthcare professionals, animal handlers, farmers and agricultural workers, sanitary workers, fishermen, hunters, and sewage workers. The clinical signs range from flu to acute kidney injury/failure, icterus, pneumonia, and pulmonary haemorrhage with many rare clinical manifestations being reported and documented worldwide. Leptospirosis poses a significant threat to both animal and human health globally. The intricate interplay between transmission dynamics, reservoir hosts, clinical manifestations, diagnosis, treatment, and preventive strategies highlights the complexity of this zoonotic disease.

Keywords: Clinical Signs; Diagnosis; Epidemiology; Leptospirosis

Abbreviations

CNS: central nervous system; EMJH: Ellinghausen McCullough Johnson Harris; µm: micrometer.

Introduction

Globally, leptospirosis is one of the most significant zoonotic bacterial diseases [1,2]. The majority of mortality and severe morbidity occur in populations with limited resources. A million cases and about 58,900 fatalities are thought to result from the infection each year, translating to a 6.85 % case fatality ratio [2]. The prevalence of leptospirosis is increasing globally with a higher incidence in developing and tropical countries [3]. This rising statistic could be attributed to the lack of accessibility to appropriate diagnostic procedures, lack of adequate knowledge on the disease prevention and control [4,5]. Leptospira is a

member of the Leptospiraceae family, order Spirochaetales [6]. They are spiral-shaped, long, thin bacteria that measure between 6 to 20 µm in length and 0.1 to 0.15 µm in thickness. Leptospires, like the majority of Gram-negative bacteria, are mottile due to their periplasmic flagellum and protein-containing outer membrane [7]. Mortality remains critical, related both to delays in diagnosis due to lack of facilities and adequate clinical evidence, and to other poorly understood reasons that may include inherent pathogenicity of some leptospiral strains or genetically determined host immune pathological reactions [8]. Leptospirosis is a treatable disease and reported from tropical regions [9]. Tropical countries with significant rainfall and humidity, as well as marshy soil and paddy-growing areas, are more prone to disease [10]. The incidence of disease prevalence is higher in these areas due to a combination of factors such as high temperature, humidity, rainfall and socioeconomic causes such as poor sanitation and close contact with domestic animals, all of which favors the growth and multiplication of Leptospira spp [11].

Based on their level of virulence, the species of the genus Leptospira have been categorised into three groups: saprophytic species, species with intermediate pathogenicity, and pathogenic species [12]. The classification unit for the many species, each of which has a unique antigenic conformation, is the serovar. Based on their antigenic similarity, more than 300 serovars have been divided into around 32 serogroups [13]. Serological investigations in cattle in different African countries revealed Leptospira spp prevalence of 10.4% to 27% in Zimbabwe 40% in Guinea Bissau 15% in Gabon 45% in Mali 27.3% in Senegal and very recently 32.3% in Nigeria [14-19]. Infections typically occur from both direct and indirect exposure or contact with the urine of infected animals and also can spread through water or soil [20]. The lack of active surveillance, awareness and a complicated clinical diagnosis is the established reasons for the rising trends of leptospirosis [21]. The most common way leptospiral organisms enters the body is through cutaneous or mucosal abrasions. When animals eat infected pasture or feedstuffs, or drink polluted water, oral transmission can occur [9]. Once the organism enters the body, it multiplies in the bloodstream, leading to its homogeneous dissemination throughout the body [9]. The pathogen affects nearly all organ systems because the spirochetes have the capability to cross tissue barriers before the antibodies of the host get an opportunity to eliminate them from the bloodstream [11]. In all animal species, the typical case fatality rate for leptospirosis is 1 to 5%. The death rate varies depending on the type of disease and is higher in the elderly. The anicteric form is rarely fatal, whereas the icteric form occurs in 5 to 10% of patients and has a case fatality rate of 54% in severe instances with cardiac involvement [22,23].

Epidemiology

Leptospirosis is described to be the most widespread zoonosis globally [23]. The source of infection in humans is presumed to be either direct or indirect contact with the urine of an infected animal. The incidence is significantly higher in warm climate countries than in temperate regions [23,24]. Leptospirosis is seasonal, with peak incidence occurring in summer or fall in temperate regions, where temperature is the limiting factor in survival of leptospires, and during rainy seasons in warm-climate regions, where rapid desiccation would otherwise prevent survival [23,25]. The mode of entry is through abrasions or cuts in the skin or via the conjunctiva; infection can take place through intact skin after prolonged stay in water [23]. Inhalation of water or aerosols also may result in infection via the mucous membranes of the respiratory tract. Rarely, infection may follow animal bites [23,26] (Table 1).

Maintenance host	Leptospira serovars
Cattle	Hardjo, Pomona, Grippotyphosa, Icterohaemorrhagiae and Canicola
Sheep and Goats	Ballum, Hardjo, Pomona, Grippotyphosa
Pigs	Pomona, Grippotyphosa, Bratislava, Canicola, and Icterohaemorrhagiae and Tarassovi
Dogs	Canicola, Icterohaemorrhagiae, Grippotyphosa, Pyrogens, Tarassovi, Pomona, Ballum and Bratislava
Rats	Icterohaemorrhagiae, and Ballum
Mice	Ballum

Table 1: Maintenance hosts of Leptospira and their associated serovars.

Reservoir Hosts

A diverse range of mammalian species serves as reservoir hosts for Leptospira spp., including rodents, livestock, wildlife, and companion animals. Rats, particularly the Norway rat (Rattus norvegicus) and the black rat (Rattus rattus), are major reservoirs in urban settings, perpetuating transmission through their ubiquitous presence and high urinary shedding rates. Livestock such as cattle, pigs, and sheep may harbor Leptospira spp. asymptomatically, serving as sources of infection for humans and other animals through direct contact or environmental contamination. Wildlife reservoirs vary by region and ecosystem, with species such as raccoons, deer, and marsupials contributing to sylvatic transmission cycles in forested and rural environments [25].

Transmission

Both direct contact with an infected animal and indirect contact with environmental media, such as soil and water, contaminated with the bodily fluids (particularly urine) of infected animals, are the main ways that leptospires are spread [27]. The bacteria frequently enter the body by the consumption of water contaminated with leptospiral, penetration through open wounds, abrasions, and mucous membranes (conjunctival, oral, conjunctival, or vaginal surfaces), eventually evading the external host tissue barriers [26]. Leptospires are very invasive because of their corkscrew-like movement, which makes it easier for them to pass through more viscous barriers, such as host connective tissues. As evidenced by the 2005 leptospirosis outbreak in Florida among peers of adventurer races that inadvertent ingestion while swimming outside may be a risk factor for leptospiral infection [27,28].

Clinical Manifestation of Leptospirosis In Animals

Clinical manifestation of leptospirosis depends on type of serovar, infectious dose, and virulence of serovar. It also depends on age, health and immunological status of the host [29]. Majority of the cases remain subclinical or asymptomatic and while symptoms are present, it typically manifests 2 - 30 days after the initial exposure [11]. Acute leptospirosis in animal is uncommon, and it has been linked to sporadic serovars such as Pomona, Grippotyphosa, and Icterohaemorrhagiae. This form affects mainly calves up to one month of age. High fever (40.5°C - 41.5°C), septicaemia, anorexia, petechiae on mucosa, acute haemolytic anemia, haemoglobinuria, jaundice, and decreased milk production in adults are all symptoms of the disease [30]. Ulceration on the cutaneous and mucous surfaces, subcutaneous oedema, gastroenteritis and cherry red coloured urine are also common finding Abortion, stillbirth, premature birth of weak calf, congenital infection, may occur in pregnant animals [30]. Ocular findings such as hemorrhages in the subconjunctival region and icterus are also observed [31]. Other symptoms seen in leptospirosis are associated with the gastrointestinal system, including nausea, vomiting, abdominal pain and diarrhea [11]. Among non-oliguric renal failure patients, gastrointestinal symptoms may contribute to dehydration [32]. The clinical manifestation of leptospirosis is biphasic, with the acute or septicemic phase lasting about a week, followed by the immune phase, characterized by antibody production and excretion of leptospires in the urine [23]. Most complications of leptospirosis are associated with localization of leptospires within the tissues during the immune phase and thus occur during the second week of the illness [23].

Diagnosis of Leptospirosis

Leptospiral infection can be diagnosed by using body fluids such as blood, urine, cerebrospinal fluids, infected tissues and so on. Leptospirosis is difficult to diagnose because of a number of factors, including the fact that not all endemic areas have access to a laboratory setup because doing so requires sophisticated laboratory and well-trained laboratory personnel, and leptospirosis can mimic other infectious agents like hepatitis and dengue fever [33]. Animal leptospirosis is frequently misdiagnosed as other illnesses with febrile syndromes due to non-specific clinical presentations or inapparent clinical signs with host-adapted serovars [34,35]. Leptospirosis can be diagnosed in the laboratory through isolation of the aetiological agent using Ellinghausen-McCullough-Johnson-Harris (EMJH) media and dark field microscopy [32]. Serological tools like enzyme linked immuno-sorbent assay, microscopic agglutination test and lateral flow and polymerase chain reaction are frequently used [33,36]. Less commonly used tests include complement fixation test, radioimmunoassay, immunofluorescence, counter immune electrophoresis, macroscope slide agglutination test and thin layer immunoassay [36].

Treatment of Leptospirosis

Treatment purely depends upon the species of the pathogen and severity of the disease [37]. Chemoprophylaxis with oral doxycycline 200 mg once a week is used when there is a high probability of disease exposure [38]. Oral azithromycin, doxycycline, ampicillin, and amoxicillin are all viable treatments for mild leptospirosis; however, doxycycline, tetracycline, ampicillin, amoxicillin, penicillin, and azithromycin are the recommended medications for severe leptospirosis and are also very effective in the early stages of the disease against Leptospira species [9]. It's also crucial to provide supportive care and manage consequences such renal failure, hepatic problems, haemorrhages, and CNS disorders [23]. If leptospirosis is detected early enough during an outbreak in a beef herd, more abortions can be averted by treating all animals with antibiotics and vaccinating the entire herd. Evaluation of novel antibiotics against Leptospira species is necessary due to the emergence of antibiotic resistance, the narrow spectrum, and multiple studies demonstrating little therapeutic benefit, including mortality, with penicillin [37].

Prevention and Control

Prevention and control of leptospirosis involve a multi-faceted approach aimed at reducing transmission, minimizing exposure, and mitigating the impact of the disease on both animal and human populations. Key strategies include:

- **Vaccination:** Vaccination of high-risk animals, such as

livestock and companion animals, is an effective measure to prevent leptospirosis. Vaccines are available for various serovars and can significantly reduce shedding of Leptospira spp. in vaccinated animals [39].

- **Biosecurity:** Implementing biosecurity measures, including rodent control, sanitation practices, and quarantine protocols, helps minimize exposure to contaminated environments and reduces the risk of transmission between animals and humans.
- **Environmental Management:** Managing environmental factors such as water sources and soil contamination is crucial for disrupting the transmission cycle of Leptospira spp. Measures may include drainage, water treatment, and habitat modification to reduce the presence of reservoir hosts and minimize exposure risk [39].
- **Surveillance:** Surveillance efforts involve monitoring animal populations for clinical cases, conducting seroprevalence surveys, and utilizing molecular epidemiology studies to track disease trends and inform control strategies. Active surveillance enhances early detection and response to outbreaks [40].
- **Personal Protective Measures:** Individuals at risk of occupational exposure, such as healthcare professionals, animal handlers, farmers, and sanitary workers, should use personal protective equipment (PPE) to minimize direct contact with infected animals or contaminated materials [9].
- **Public Awareness and Education:** Increasing awareness about leptospirosis and its transmission routes is essential for promoting preventive behaviors among at-risk populations. Education campaigns can emphasize the importance of vaccination, hygiene practices, and timely seeking medical care for suspected cases [32].
- **Collaboration and Coordination:** Collaboration between veterinary and public health authorities, as well as interdisciplinary cooperation among stakeholders, is critical for effective leptospirosis control. Coordinated efforts facilitate the implementation of comprehensive control measures and enhance surveillance and response capabilities [41].

Conclusion

Leptospirosis poses a significant threat to both animal and human health globally. The intricate interplay between transmission dynamics, reservoir hosts, clinical manifestations, diagnosis, treatment, and preventive strategies highlights the complexity of this zoonotic disease. Understanding the epidemiology of leptospirosis in animals is essential for implementing effective control measures and reducing the burden of disease on both veterinary and public health fronts. Through continued research, surveillance, and collaboration, we can strive towards a future where leptospirosis is adequately managed, and its impact on animal and human populations is minimized. It is imperative to emphasize the importance of preventive measures such as vaccination, biosecurity, environmental management, and surveillance in mitigating the spread of leptospirosis and safeguarding both animal welfare and public health.

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