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Review Article

Leptospirosis: Transmission, Pathogenesis, Diagnosis and Prevention: A Comprehensive Review

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ABSTRACT

Leptospirosis is a globally prevalent zoonotic infection caused by *Leptospira* spp. This review provides a comprehensive overview of leptospirosis, focusing on its transmission, pathogenesis, diagnostic methods and preventive measures. The disease poses a significant public health threat, particularly in tropical and subtropical regions and is primarily transmitted through contact with contaminated water, soil, food and urine from infected animals. Leptospirosis can manifest as a wide range of symptoms, from flu-like illness to severe organ failure with potentially fatal outcomes. Early diagnosis and timely treatment are crucial in managing the infection effectively. Diagnostic techniques, including culturing, molecular testing, serological assays and microscopic examination, play a vital role in identifying the presence of *Leptospira* and confirming the diagnosis. Additionally, preventive measures such as environmental hygiene, rodent control, personal hygiene practices and region-specific vaccination strategies are essential in reducing the incidence and spread of leptospirosis. This multidisciplinary review underscores the importance of a comprehensive approach in combating this potentially dangerous infection and highlights the significance of ongoing research and surveillance efforts to mitigate the global burden of leptospirosis.

INTRODUCTION

Leptospirosis also known as Weil's disease, is a significant global health threat caused by the *Leptospira* spp. It is a neglected zoonotic infection that poses a serious challenge to public health worldwide. The *Leptospira* family consists of a variety of species, including non-pathogenic, pathogenic and transitional strains, characterized by genotypic variations (Desvars *et al*., 2011; Karpagam and Ganesh, 2020). Serological classification divides the approximately 300 serovars into different serogroups (Picardeau, 2017). These gram-negative (-), slowly growing spirochetes are typically 6-20 mm long, 0.1 mm wide and have pointed ends curved like hooks (Picardeau, 2017; Ramalakshmi *et al*., 2021).

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Leptospirosis predominantly affects mammalian species residing in warm and humid environments, where favorable environmental and climatic conditions facilitate the prolonged survival and transmission of the bacteria (Bandara *et al*., 2014). The ideal growth temperature for *Leptospira* is around 28-30°C, with a pH range of 6.8-7.6 (Bandara *et al*., 2014; Picardeau, 2017). Both animals and humans can be infected, infected animals acts as reservoir hosts and can directly or indirectly transmit the disease to humans through contact with infectious secretions such as blood, urine, contaminated food, water and uterine discharge (Pappas *et al*., 2008). *Leptospira* replicates in various organs including the liver, kidney and spleen, causing damage to vital systems (Schuller *et al*., 2015). Certain occupations, such as meat processors, farmers, veterinarians, theriogenologist and lab workers are at a higher risk of contracting leptospirosis due to their close contact with infected animals and contaminated environments (Terpstra *et al*., 1985; Motto *et al*., 2021; Samrot *et al*., 2021). However, indirect exposure to contaminated environments such as unhygienic conditions is the most common mode of human infection with *Leptospira* (Galarde-López *et al*., 2021; Sykes *et al*., 2022). The global epidemiological picture of leptospirosis is inconsistent with an estimated 1.03 million human

infections and 58,900 deaths reported annually (Haake and Levett, 2014; Fernandes *et al*., 2019). The economic impact of leptospirosis is significant with high treatment costs, animal culling and reduced reproductive rates contributing to substantial economic losses (Weil, 1886; Durski *et al*., 2014).

Accurate diagnosis is a crucial step in achieving better outcomes for leptospirosis patients. Several laboratory techniques including culturing, molecular methods, serological tests and microscopic examination are employed to detect *Leptospira* infection (Calvopiña *et al*., 2022). Effective antibiotics for treating leptospirosis include penicillin, ampicillin, streptomycin, tetracycline and doxycycline, although preventive measures can also help to reduce the risk of infection (Tomckowiack *et al*., 2022). In light of these concerns, this review paper aims to provide a concise overview of leptospirosis, including its transmission, pathogenesis, clinical presentation, diagnostic methods and preventive measures, emphasizing the importance of a multidisciplinary approach to successfully combat this potentially dangerous infection.

History

Leptospirosis, initially characterized by Weil (1886), it is commonly referred to as Weil's disease due to its clinical manifestations, including icterus, splenomegaly, renal failure and conjunctivitis (Weil, 1886). However, descriptions of a disease closely resembling leptospirosis can be found in ancient texts such as cane cutters disease, rice field jaundice, and autumn fever. In 1907, the causative organism of leptospirosis was identified by Stimson. Spirochaetes were found inside the kidneys of a patient who had died from the disease, leading to the naming of the organism as Spirochaeta interrogans due to its question-mark shape (Levett and Whittington, 1998; Sunil *et al*., 2016). This discovery marked a significant milestone in the identification and characterization of the bacterium responsible for leptospirosis. Since then, extensive research has been conducted to better understand the epidemiology, pathogenesis and clinical presentation of leptospirosis. Advancement in diagnostic techniques including serological tests and molecular methods have contributed to improved detection and identification of the *Leptospira* bacteria (Levett, 2001). Over the years, the global impact of leptospirosis has become increasingly recognized, leading to efforts in development of preventive strategies and treatment protocols. The historical milestones and key discoveries in the identification and characterization of leptospirosis have laid the foundation for ongoing research and interventions aimed at combating this significant global health threat.

Taxonomy and classification

The *Leptospira* bacteria are free living microorganisms that exhibit a size range of 6 to 20 µm, with a distinctive hooked shape and an estimated width of 0.1 µm. Their surface architecture consists of a peptidoglycan outer cell wall, a cytoplasmic membrane and an outer membrane sheath composed of a lipid bilayer, contributing to their characteristics as both Gram-negative and Gram-positive bacteria (Evangelista and Coburn, 2010). These bacteria are motile using endoflagella, which allows them to move in a spiral manner. The classification of *Leptospira* is complex. There are two main species: *L. biflexa*, which encompasses all saprophytic strains and *L. interrogans*, which includes the pathogenic strains (Rajapakse, 2022). Currently, *Leptospira* is classified based on genotypes and serovars. There are approximately 21 species, with nine of them being pathogenic and the remaining strains are categorized as non-pathogenic based on their genotypes. The majority of pathogenic strains belong to the species *L. interrogans* (Sunil *et al*., 2016; Rajapakse, 2022). Serological testing rather than DNA analysis is used to classify serovars and serogroups of *Leptospira*. There are several serogroups consisting of approximately 300 recognized serovars. Among these, a small number are pathogenic. Serovars within the same serogroup may exhibit genetic variations, while strains belonging to different serogroups may have DNA that is similar to one another (Ramalakshmi *et al*., 2021). The taxonomy and classification of *Leptospira* bacteria based on genotypes and serovars play a crucial role in understanding the pathogenicity and epidemiology of different strains. This classification system allows for the identification and differentiation of various *Leptospira* species and serovars, aiding in diagnostic and epidemiological studies related to leptospirosis (Hajra *et al*., 2016).

TRANSMISSION AND PATHOGENESIS

Modes of transmission

LPS can be transmitted through various modes, both directly and indirectly. The *Leptospira* species can spread through the ingestion of contaminated food or water, inhalation of contaminated water or urine aerosols and direct contact with infected urine or tissues. The bacteria can enter the host through mucous membranes or damaged skin and it has been observed that they can even penetrate through submerged damaged skin. Other modes of transmission include rodent bites, sexual contact and lactation (Abela-Ridder *et al*., 2010; Tilahun *et al*., 2013; Samrot *et al*., 2021).

Pathogenic mechanisms

Leptospires gain entry into the host through sites

such as the epidermis, conjunctiva, mucous membranes and vaginal openings. Transmembrane passageways and chemotaxis pathways play a role in their adhesion. Once inside the host's vascular compartment the bacteria can persist for weeks to months, particularly settling in the kidney tubules. The presence of *Leptospira* in the blood and tissues at high levels leads to the development of lesions caused by toxic cellular components. Some serovars of *Leptospira* exhibit endotoxin activity, similar to other Gram-negative bacteria. Hemolysins, which are phospholipases that may contribute to cytolysis of red blood cells and other cell membranes (Thompson *et al*., 1986; Lee *et al*., 2002; Sykes *et al*., 2022).

Under optimal conditions, *Leptospira* can reach a density of 10^9 cells per milliliter, with a doubling time of 6 to 8 hours. While saprophytic strains can grow on solid media relatively quickly, other strains may require more time to establish (culturing) (Tilahun *et al*., 2013).

Pathogenesis

Repeated entry of *Leptospira* into a susceptible host leads to the development of various manifestations of the disease. The major lesions caused by the bacteria damage the endothelium of small blood vessels, resulting in meningitis, myositis, placentitis, renal tubular necrosis, hepatic damage and pulmonary damage. The severity and incubation period of the disease depend on factors such as the growth rate, toxicity and immune response of the bacteria (Haraji *et al*., 2011). The molecular basis for pathogenicity in *Leptospira* has been largely unknown until recently due to the lack of genetic tools for manipulation. However, recent advancements in mutagenesis techniques have provided insights into the molecular and cellular pathways involved in pathogenicity (Sykes *et al*., 2022). The humoral immune response is triggered about one week after infection leading to phagocytosis by neutrophils and macrophages. Complement activation also plays a role in the lysis of *Leptospira* due to their multiplication. Initial infection in susceptible hosts is characterized by symptoms such as severe chills, fever, headache, myalgia and retro-orbital pain. After an incubation period of approximately 10 days (ranging from 4 to 19 days) additional symptoms may arise including jaundice, hepatic-renal failure, myocarditis, meningitis and bleeding into the skin and mucous membranes (Bourhy *et al*., 2005; Mansour-Ghanaei *et al*., 2005; El-Latif, 2007; Mohammed *et al*., 2011). The transmission and pathogenesis of leptospirosis involve complex interactions between the bacteria and the host, leading to a wide range of clinical manifestations. Understanding these mechanisms is crucial for the development of effective diagnostic methods and preventive measures (Sykes *et al*., 2022).

HOSTS

Leptospirosis can affect a wide range of animal hosts including both reservoir hosts and incidental hosts. The role of these hosts in the transmission of leptospirosis varies depending on the serovar and location. Here is a comprehensive list of animal hosts and their involvement in the transmission of leptospirosis:

Reservoir hosts

Rodents: Rodents particularly rats serve as the primary reservoir hosts for many *Leptospira* serovars (Faine *et al*., 1982). Rats such as the brown rat (*Rattus norvegicus*) and black rat (*Rattus rattus*) are important carriers of the bacteria and play a significant role in the transmission to humans and other animals.

Livestock: Cattle, pig, sheep and other livestock can act as temporary carriers of *Leptospira*, contributing to the transmission of the disease. However, their role as reservoir hosts may vary depending on the serovar and geographical location (Durski *et al*., 2014).

Incidental hosts

Dogs: Dogs can become infected with *Leptospira* and act as incidental hosts. They can acquire the infection through contact with contaminated water or urine from infected animals. Infected dogs can potentially transmit the disease to humans and other animals.

Wildlife: Various wildlife species including raccoons, opossums, deer and wild boars can serve as incidental hosts for different *Leptospira* serovars. These animals can become infected through exposure to contaminated environments or contact with infected reservoir host.

Marine mammals: Certain marine mammals including seals and sea lion have been identified as incidental hosts for *Leptospira*. They can become infected through exposure to contaminated water or contact with infected animals.

It is important to note that all animals including humans can be susceptible to at least one strain of *Leptospira*. While some animals act as reservoir hosts and maintain the infection within their populations, others may become incidentally infected without playing a significant role in the transmission cycle. Asymptomatic or mild illness is more common in reservoir hosts, while incidental hosts may exhibit a range of clinical signs and symptoms (Tilahun *et al*., 2013).

The diverse range of animal hosts involved in leptospirosis transmission highlights the complex nature of the disease and the need for comprehensive surveillance and control measures to mitigate its impact on both animal and human health (Sykes *et al*., 2022).

CLINICAL SYMPTOMS

Leptospirosis can manifest with a range of clinical symptoms in both humans and different animal species. Here is a more detailed description of the clinical symptoms observed:

Cattle: Cattle affected by leptospirosis may experience a sudden decline in milk yield, unusual mastitis and fever. They may also exhibit complications such as abortion with retained placenta, severe anemia, considerable jaundice, an enlarged and friable liver, swollen kidneys, hemoglobinuria, dyspnea, meningitis, rapid dehydration and even death (Cachay and Vinetz, 2005; Tilahun *et al*., 2013).

Pigs: Leptospirosis infection in pigs is often subclinical, meaning they may not display apparent symptoms. However, some pigs may exhibit symptoms such as conjunctivitis and periodic ophthalmia (Tilahun *et al*., 2013).

Dogs and cats: In dogs and cats, leptospirosis can result in various clinical symptoms including nephritis, jaundice and gastroenteritis (Cachay and Vinetz, 2005; Tilahun *et al*., 2013).

In humans the clinical presentation of leptospirosis can vary depending on the serovar involved and the sensitivity of the host. The incubation period typically ranges from two to twenty-one days with an average of ten days (Cachay and Vinetz, 2005). The majority of symptomatic cases in humans present as flu-like illness and are self-limiting. However, approximately 5% to 10% of cases can lead to severe complications such as liver failure, renal failure and hemorrhagic pneumonitis. Men have shown to be more susceptible to developing severe illness than women (Tilahun *et al*., 2013).

The typical clinical syndrome of leptospirosis in humans consists of two stages: An immunological phase and an asepticemic phase (Tilahun *et al*., 2013). During the immunological phase more severe illness and organ-specific damage may occur. Common symptoms observed in human cases include myalgia, conjunctival suffusion, fever, headache, and chills. Less common symptoms may include biphasic fever, meningitis, photosensitivity, dermatitis and renal or hepatic failure (Tilahun *et al*., 2013; Motto *et al*., 2021).

LABORATORY DIAGNOSIS OF LETOSPIROSIS

Leptospira infection is often challenging to identify and can be misdiagnosed as other illnesses with similar symptoms. However, accurate identification of the etiology and confirmation of clinical cases are crucial for effective prevention measures and appropriate treatment. Laboratory tests play a key role in achieving a precise diagnosis of leptospirosis (Chancharoenthana *et al*., 2022). There are several techniques used for the diagnosis of leptospirosis, including direct detection of spirochetes and their components in physiological tissues and fluids, as well as the detection of antibodies during different clinical phases. Cultivating and isolating the pathogen can also help identify infectious serovars, although this method is imprecise and time-consuming requires weeks of incubation (Pal *et al*., 2022). Serologic tests using serum samples are commonly employed for diagnosing leptospirosis in patients (Ahmad *et al*., 2005). These tests involve the detection of antibodies specific to *Leptospira* antigens. Additionally, both direct and indirect methods are utilized for the diagnosis of leptospirosis (Gasem *et al*., 2020; Pal *et al*., 2022).

Direct diagnosis procedures

Microscopy

Microscopy involves the direct observation of leptospires in clinical specimens. However, using microscopy for diagnosis may have low specificity, particularly when observing leptospires in urine samples as protein and fibrin present in the urine can be mistaken for leptospires. Contrast microscopy, such as dark-field microscopy or phase-contrast microscopy can aid in the visualization of colorless or unstained specimens that are transparent and difficult to detect. Contrast microscopy is commonly employed in the laboratory, although the optical properties and technological limitations of thick suspensions can affect the results (Budihal and Perwez 2014; Samrot *et al*., 2021).

Staining methods

Staining methods involve the use of various dyes to detect leptospires in clinical specimens. Silver stains have been found to be useful, although the LPS load in tissue biopsies like kidneys may not always be substantial. The warthin-starry stain, a histopathological stain is currently utilized to overcome false negative results. Immunohistochemistry assays and IgG fluorescence labeling, in addition to histopathological stains have shown to be valuable diagnostic tools for detecting leptospirosis. Immunoglobulin staining is often performed on tissues positive for Leptospiral antigens (Wild *et al*., 2002; Azizi *et al*., 2014; Gunasekara *et al*., 2017).

Culture technique

Culture techniques involve the cultivation and isolation of leptospires from clinical samples. The most commonly used medium is EMJH (Ellinghausen-

McCullough-Johnson-Harris) medium which contains albumin and oleic acid. The medium consists of essential components such as ammonium chloride, thiamine, disodium phosphate, monopotassium phosphate, tween 80 and egg whites. Samples suspected of containing the pathogen are streaked onto culture flasks filled with the appropriate fluid medium, which can be urine or blood. Antibiotics like rifampin, neomycin and actidone are added to prevent bacterial contamination. Leptospires can be successfully cultivated from cerebrospinal fluid and blood samples during the acute phase of the disease. However, this culture procedure is time-consuming, laborious and requires strict biosafety measures due to the highly infectious nature of leptospires (Miraglia *et al*., 2009; Budihal and Perwez, 2014).

Polymerase chain reaction (PCR)

PCR is a molecular technique used to amplify the DNA content of a sample, making it crucial when the DNA content is assumed to be minimal or undetectable. PCR can easily identify leptospires in the early stages of infection using urine or blood samples. During acute leptospirosis, the antibody titer might not be high enough for a precise serological diagnosis compared to more established techniques like culturing, making PCR results significantly faster. PCR targets specific regions of the Leptospiral DNA, including 16S ribosomal RNA and specific pathogenic genes. Following PCR amplification, agarose gel electrophoresis is performed to visualize the amplified DNA fragments. Real-time multiplex PCR assays have been developed to enhance diagnostic sensitivity and specificity by using multiple sets of primers and targets. Nested PCR, which utilizes two sets of primers, can identify more delicate and specific DNA sites (Bal *et al*., 1994; Brown *et al*., 1995; Merien *et al*., 2005; Natarajaseenivasan *et al*., 2012; Shafighi *et al*., 2014; Blanco and Romero, 2014).

Techniques for serology and indirect diagnostics

Serological tests play a crucial role in the diagnosis of leptospirosis by detecting specific antibodies against Leptospiral antigens. These tests are commonly performed on serum samples from individuals suspected of having leptospirosis. Serology is particularly important because leptospires have long doubling times in culture and culture-based methods require weeks to yield results (Sykes *et al*., 2022).

Microscopic agglutination test (MAT)

MAT is widely used for diagnosing leptospirosis (Galton, 1958). It detects antibodies produced against specific *Leptospira* serovar antigens. This test involves using live bacterial cultures and frequently includes a panel of different serovars of *Leptospira* in the test serum (Musso *et al*., 2013). The MAT titer is determined by testing various dilutions of the serum with a panel of positive serovars. A four-fold rise in MAT antibody titer provides definitive evidence of *Leptospira* infection. Due to its high sensitivity and ability to identify group-specific antibodies, the MAT is considered the gold standard for diagnostic procedures (Chirathaworn *et al*., 2014; Lizer *et al*., 2017). However, the complexity of the test makes it challenging to scale up for a large number of samples, leading to the development of more efficient diagnostic methods.

Microsphere immunoassay (MIA)

MIA is a commonly accepted method for diagnosing leptospirosis, particularly when MAT interpretation relies heavily on actual cultures and subjective observations. MIA employs Luminex xMAP technology to identify materials that were previously considered non-reactive. It can also distinguish between *Leptospira*-specific IgM and IgG antibodies. The test utilizes IgG and IgM immunoassays and antigens derived from purified *Leptospira* cultures. MIA successfully identifies the type of antibody and the reactivity of the antigens and it allows for bulk sampling against multiple serovars, leading to cost reduction in diagnosis (Lizer *et al*., 2017).

Enzyme-linked immunosorbent assay (ELISA)

ELISA is another method used to detect leptospirosis by utilizing Leptospiral-specific IgM and IgG antibodies derived from the serum of infected individuals. Even in the presence of low antigen titers, specific IgM and IgG antibodies produced by leptospirosis patients can be identified by ELISA (Hartman *et al*., 1984; Terpstra *et al*., 1985). ELISA is commonly employed to find Leptospiral antibodies in sera for both diagnostic and epidemiological purposes due to its specificity and sensitivity. Immunodiffusion and immunoelectrophoresis techniques are used to confirm the specificity of antisera against human IgM and IgG immunoglobulins (Adler *et al*., 1980; Desakorn *et al*., 2012).

Direct hemagglutination assay (IHA)

IHA is a useful first-line diagnostic tool for suspected cases of acute leptospirosis. One of the major advantages of this assay is that it does not require specific incubation conditions. However, the interpretation of IHA results can be challenging when there is nonspecific hemagglutination. This test can detect antibodies against *Leptospira* antigens, specifically immunoglobulin M and immunoglobulin G (IgM-IgG), within five to six days of bacterial invasion.

It demonstrates a diagnostic sensitivity of 92% and a specificity of 95% (Levett and Whittington, 1998; Hajra *et al*., 2016).

Dipstick assay

The dipstick assay is a simple and reliable method for rapidly screening and identifying leptospirosis, particularly in the field. It does not require specialized laboratory equipment or trained personnel. The LEPTO dipstick test is designed to quickly detect leptospires. It utilizes a dipstick with two horizontal bands: the upper band serves as an internal control containing anti-human IgM and the lower band consists of immobilized specific antigens with stabilized anti-human IgM colloidal gold conjugate. Bound IgM antibodies are detected in non-enzymatic reactions with sensitivity comparable to that of ELISA and IgM tests (Gussenhoven *et al*., 1997; Hatta *et al*., 2000; Samrot *et al*., 2021).

Flow cytometry test (FCM)

FCM is employed for the analysis of leptospirosis due to its high sensitivity through fundamental scattering parameters such as forward scatter (FSC) and side scatter (SSC) (Tzur *et al*., 2011). SSC correlates with the granularity of bacteria, while FSC is associated with cell size and the surface membrane's optical refraction index. FCM allows for the detection and analysis of particles with a width of less than 0.5 µm, enabling leptospires to be identified (Headland *et al*., 2014). FCM utilizes a laser beam-emitting excitation light source, an amplifier to magnify the signal, and detectors such as photodiodes or photomultipliers to detect the amplified signal (Schmit *et al*., 2021). FCM is more efficient, takes about one and a half hours to complete, and offers greater specificity and sensitivity for diagnosis compared to other methods (Yitzhaki *et al*., 2004).

Differential diagnosis

When evaluating a patient with symptoms that may be consistent with leptospirosis, it is essential to consider other possible diagnoses to ensure accurate identification and appropriate management. Here are some differential diagnoses to consider:

Kawasaki disease: Kawasaki disease is an acute febrile illness that primarily affects children. It presents with symptoms such as fever, rash, conjunctivitis, oral mucosal changes, and swollen lymph nodes. Although there may be some overlapping symptoms, Kawasaki disease typically does not involve renal or hepatic manifestations seen in leptospirosis.

Hepatitis A: Hepatitis A is a viral infection that affects the liver. It is transmitted through contaminated food or water. Symptoms include fever, jaundice, fatigue, abdominal pain, and nausea. Hepatitis A can be differentiated from leptospirosis by the absence of characteristic findings such as conjunctival suffusion and muscle pain.

Dengue and other viral infections: Dengue fever and other viral infections, including enterovirus infections, can present with symptoms similar to leptospirosis, such as fever, headache, muscle and joint pain, and rash. However, in these cases, patients often have distinct clinical features such as hemorrhagic manifestations or specific diagnostic markers that can help differentiate them from leptospirosis.

Hantavirus pulmonary syndrome: Hantavirus pulmonary syndrome is a severe respiratory illness caused by infection with hantaviruses. It is transmitted through contact with infected rodents. Symptoms include fever, muscle pain, cough, and shortness of breath. Leptospirosis can be distinguished from hantavirus pulmonary syndrome by the presence of characteristic renal involvement and a history of exposure to contaminated water or animals.

Malaria: Malaria is a parasitic infection transmitted through the bite of infected mosquitoes. It typically presents with recurrent episodes of fever, chills, and sweating. Laboratory testing, including blood smear examination, can confirm the diagnosis of malaria and differentiate it from leptospirosis.

Measles: Measles is a highly contagious viral infection characterized by fever, cough, runny nose, and a characteristic rash. While there may be some overlap in symptoms such as fever and rash, leptospirosis is distinguished by its renal and hepatic involvement and a history of exposure to contaminated water or animals.

Meningitis: Meningitis is an inflammation of the membranes surrounding the brain and spinal cord, usually caused by a bacterial or viral infection. It presents with symptoms such as fever, headache, neck stiffness, and altered mental status. Diagnostic tests, such as cerebrospinal fluid analysis, can differentiate meningitis from leptospirosis.

Q fever: Q fever is a bacterial infection caused by *Coxiella burnetii*. It primarily affects the respiratory system and can present with symptoms similar to leptospirosis, including fever, headache, and muscle pain. However, characteristic findings such as hepatosplenomegaly and jaundice are not typically seen in Q fever.

THERAPY OF LEPTOSPIROSIS

Leptospirosis is caused by the *Leptospira* bacteria, which is transmitted through contact with contaminated food, urine, or soil that is tainted by rodent, cattle, or pet urine. The treatment and prevention strategies for

leptospirosis include the following:

Antibiotics: The primary treatment for leptospirosis involves the administration of antibiotics to eliminate the bacteria from the body. Antibiotics such as doxycycline or penicillin are commonly used. Early initiation of antibiotic treatment is crucial to prevent complications (Ananda and Dsouza, 2008). In animals, various antibiotics such as ampicillin, ofloxacin, enrofloxacin, ciprofloxacin, doxycycline, and oxytetracycline are used for the treatment of leptospirosis in species like hamsters, pigs, and cattle (Langston and Heuter, 2003).

Supportive care: In severe cases of leptospirosis, hospitalization may be necessary to provide supportive care. This may include intravenous fluids to prevent dehydration, treatment of complications such as kidney or liver failure, and respiratory support if needed (Soo *et al*., 2020; Durski *et al*., 2014). Supportive care aims to manage symptoms, maintain organ function, and aid in the recovery process.

PREVENTION OF LEPTOSPIROSIS

Preventing leptospirosis involves implementing measures to avoid contact with contaminated water, soil, and animals. Here are some preventive measures:

Avoidance of contaminated environments: Individuals should avoid contact with water or soil that may be contaminated with animal urine. This includes avoiding swimming or wading in bodies of water that may be contaminated, especially in areas known to have a high prevalence of leptospirosis. Protective clothing, such as gloves and boots, should be worn when handling animals or working in environments that may be contaminated.

Rodent control: Controlling rodent populations can help reduce the transmission of leptospirosis. This can be achieved by implementing effective waste management practices to reduce food sources for rodents, sealing entry points to prevent their entry into buildings, and using appropriate rodenticides or traps to reduce their numbers near populated areas.

Personal hygiene: Practicing good personal hygiene is essential in preventing leptospirosis. This includes washing hands thoroughly with soap and water after contact with potentially contaminated environments or animals. It is especially important to wash hands before handling food or touching the face.

Vaccination (for animals): Vaccination is available for some animal species, such as dogs and cattle, to prevent leptospirosis. Vaccinating animals can reduce the risk of transmission to humans and protect the animals themselves from infection.

By implementing these preventive measures, individuals can reduce their risk of contracting leptospirosis and minimize the spread of the disease in communities (Karpagam and Ganesh, 2020; Ramalakshmi *et al*., 2021).

EPIDEMIOLOGY AND RISK FACTORS IN PAKISTAN

The findings revealed a 40.83% (95 percent CI; 35.71-46.11) total prevalence. Leptospiral prevalence varied significantly (p .05) across 3 distinct geographical areas, with the subtropical humid climate locale having the greatest prevalence (50.83%; 95% confidence interval (CI): 41.55-60.07); the area with a semi-arid climate having the second-greatest prevalence (44.16%; 95 percent CI: 35.11-53.52); and the hot and dry region having the least prevalence (27.50%; 95 percent CI: 19.75-36.40). Gender, age, usage of flooding water, the source of water used, the frequency of environment disinfection, and a history of cuts and wounds were revealed to be substantially linked with the positive serology of *Leptospira* following multivariate analysis (Sohail *et al*., 2020).

The total seroprevalence in Pakistani individuals throughout the current investigation was 40.83% (CI: 35.71-46.11). Leptospiral seropositivity has been demonstrated to differ statistically significantly (P 0.05) between areas. Lahore came in second (44.16%, CI: 35.11-53.52) and Bahawalpur on third (27.50%, CI: 19.75-36.40), with Rawalpindi having increased seroprevalence (50.83%, CI: 41.55-60.07). Using a univariate logistic regression (LR) model, an aggregate of fifteen variables were examined (Sohail *et al*., 2020). Leptospirosis risk factors may include overpopulation, insufficient sanitation, and insufficient personal hygiene. The illness is more prevalent in regions where there is standing water after a strong downpour (Sharma *et al*., 2006).

CONCLUSION

Leptospirosis is a significant zoonotic disease that affects both humans and animals. It is commonly referred to as Weil's disease in humans. The severity and clinical presentation of the disease can vary widely. The primary source of infection is the contaminated urine of infected animals. Timely and accurate diagnosis of the infection using laboratory tests allows for appropriate antibiotic treatment. Implementing proper hygiene practices and taking sterile precautions are essential for the prevention of leptospirosis in both humans and animals. By raising awareness about the disease, promoting early diagnosis, and implementing preventive measures, we can effectively manage and reduce the impact of leptospirosis on public health.

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