



## PROFILE AND CHARACTERIZATION OF THE BACTERIA CAUSING SYPHILIS DISEASE

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### Abstract

This research deals with a comprehensive view of the bacteria that cause Syphilis, which is one of the common sexual diseases spread widely in all countries of the world and this disease is caused by bacteria *Treponema pallidum* and this research indicates the pathogenicity of this bacteria as well as the spread of the disease where Syphilis is divided into different sections and is considered a chronic disease. This research sheds light on the elements of virulence and resistance to antibiotics, including antibiotics such as penicillin,  $\beta$ -lactam and macrolides antibiotics whose effect is either inhibitory or fetal (bacteriostatic or bactericidal) to pathogenic bacteria. Vaccination has been demonstrated through the activity of antibodies with antigens.

**Keywords:** Syphilis disease, *Treponema pallidum*, Gram- negative bacteria, Virulence features.

### Introduction

#### Syphilis:

Syphilis is a problem that affects health mainly in the world, and the World Health Organization has identified nearly six million cases of infection in all countries of the world during 2016.<sup>1</sup>

Syphilis is a chronic disease, a multiple systemic transmitted through sexual contact, caused by bacteria *Treponema pallidum* (*T. pallidum*). The disease cases are estimated during the year five millions cases in all countries of the world. The disease



usually occurs in low- and middle – income areas, and for this reason, the lower disease can be the main cause of the spread and speed of transmission of disease acquired immunodeficiency syndrome in poor areas.<sup>2,3</sup>

In the event that syphilis is not treated, it leads to morbid conditions, an increase in the number of deaths, and the emergence of serious diseases.<sup>4</sup>

### **Pathogenicity:**

The pathogen of syphilis is bacteria *Treponema pallidum*, and this bacteria cannot be cultured routinely in laboratory, and this leads to the adoption of the molecular epidemiological study more widely than the routine study.

It is considered a technical challenge and thus limits the understanding of syphilis at present, and genome sequencing technology has been adopted to enhance and clarify the way the disease appears and develops. 3–5 Many studies have shown the spread of two basic strains of TPA lineages (Nichols and SS14) in different countries of the world with the spread of the population significantly at the beginning of the current century, and this corresponds of the emergence of the disease on a global level.<sup>5,6</sup>

*Treponema pallidum* is a spiral- shaped bacteria, divided into subtypes, syphilis is transmitted between humans.<sup>7</sup> A microscopic organism shaped like a coiled helix,<sup>8</sup> which lacks the carboxylic acid cycle or phosphorous oxidation, which reduces metabolic.<sup>9</sup>

The pathogenic agent process a cytoplasmic and an exterior membrane. Consuming light microscopy, this bacteria can only identified by using a dark field microscope.<sup>9</sup>

### **Epidemiology:**

Syphilis is divided into different stages and is considered a chronic disease. The method of transmission of the disease through sexual contact or during pregnancy is transmitted through the placenta.<sup>10</sup> The number of cases that occur annually is estimated at approximately 12 million cases.<sup>11</sup> Reports indicate that more than half of infected pregnant women will be exposed to a stillbirth or the death of the fetus during child birth or the transmission of the disease to the newborn, according to the World Health Organization (WHO) reports,<sup>12</sup> This disease has been considered one of the five most important infectious disease according to what has been reported, and it is the most common disease among the sexually transmitted diseases.<sup>11,13</sup>

It is noticeable that the incidence of Syphilis has increased significantly in high-income countries, including Australia, during the past decade,<sup>14</sup> The infection rate in Australia is estimated at 358% for a period from 2009 to 2019.<sup>15</sup>



In syphilis studies, the rabbit is used, which is the most used animal models because of the occurrence of pathological changes and the sero- immune response after infection with bacteria *T. pallidum* and same response that occurs in humans. The pathogenesis of Syphilis is still understood despite the early microscopic identification of the bacteria, and the reason for this is due to the difficulty of genetic manipulation in an in vitro animal model as well as appropriate immunological assay.<sup>16,17,18,19</sup>

In addition, mice were used in the study of infectious diseases, and these mice have well- defined genetic and immune properties. The syphilis bacteria were studied on mice, the infection and the persistence of bacteria inside mice were observed.

Conversely, the infection was observed in mice, but no skin lesions appeared, as happened in other animal laboratory models.<sup>20,21,22</sup>

There are no recent studies showing the advantages and disadvantages of using mice in the study of syphilis bacteria, and there are no results of the relationship between the spread of pathogenic bacteria and the immune response of mice and the severity of the disease.

In spite of the presence of reasonable and active treatment of microbes using antibiotics, syphilis could be improved expressively among weak collections such as prisoners, who are considered to be at higher risk of contracting sexually transmitted diseases.<sup>23,24</sup>

Where many studies have shown a clear increase in cases of syphilis among prisoners, despite the development of methods of treatment of this disease.<sup>25,27</sup>

The great existence of syphilis can participate into *T. pallidum* diffusion amongst prisoners, as well the common people,<sup>25,26,28</sup> In addition, Syphilis is reflected one of the most important features that facilitate the diffusion of human immunodeficiency virus, and in turn, the human immunodeficiency virus facilitate an increase in the incidence of Syphilis and its reaching progressive phases.<sup>29</sup> This disease threatens the public health of societies, and for the purpose of controlling it, some standard measures are required to eliminate infection through a serological examination.<sup>25,28</sup>

### **Virulence factors:**

*Treponema pallidum* is Gram- negative, spiral- shaped bacteria containing an outer membrane, an inner membrane, a protoplasmic cylinder, and a circumferential space around the outer membrane.<sup>30</sup> It has an endoflagella (periplasmic flagella) containing of four central polypeptides, a core construction, and a sheath.[citation needed] The flagella is placed with the periplasmic space and wraps around the protoplasmic tube. *T. palladium's* external membrane has the most connection within host cells and has



few trans membrane proteins, regulating antigenicity though its cytoplasmic membrane is shielded in lipoproteins.<sup>31,32</sup>

The exterior membrane of Syphilis bacteria acts and its primary function is through contact with cells of the host.<sup>33</sup> Below the cytoplasmic membrane of Syphilis bacteria, there are strips of cytoplasmic filaments on the exoskeleton and extending along the length of the cell. These strips consist of a protein and their function is unknown.<sup>32,34</sup> There is a decrease in infections with an increase in the immune response against the pathogenic bacteria. And in many cases, a continuation of the latent infection that is produced for a long period of life.<sup>35</sup>

### **Antimicrobial resistance:**

Studies have indicated the use of the rabbit model with the participation of the antibiotic penicillin in the treatment of drug addiction for a long period of life during the period of the forties of the last century. These experimentations are considered the main element that was used by scientists in finding a treatment for the bacteria that cause syphilis. The Syphilis bacteria are inactivated during a period of 6 to 8 hours by the use of the antibiotic penicillin with the renewal of cells in the lymph nodes, In addition to penicillin, antibiotics can be used, such as  $\beta$ -lactam or macrolides antibiotics to inhibit syphilis bacteria.<sup>36</sup> It has shown resistance to some antibiotics such as macrolides. The cause of macrolides resistance in syphilis bacteria is through the presence of single point mutation and helped increase the viability of bacteria.<sup>37</sup>

### **Treatment:**

The specific doses of the antibiotic penicillin have an inhibitory effect on bacterial growth in the treatment of syphilis bacteria, while the doses used in large concentrations have a fetal effect on bacterial growth.<sup>36,37</sup> Penicillin is the most effective antibiotic in the treatment of syphilis and it can have a fetal or inhibitory effect, depending on the dose used. With an increase in concentration, the effectiveness of penicillin increases in treating the disease.<sup>37</sup>

### **Vaccination:**

In the outer envelope of Syphilis bacteria there are very few proteins that are considered superficial and have an effective role in stimulating antibodies, and there is no vaccine for Syphilis bacteria until the year 2017. Many efforts have been made to find a vaccine that is safe and highly effective, but these efforts encountered difficulties due to the lack of interest in studying the mechanisms of humoral and





cellular immunity to visit from the disease, <sup>38</sup> for the reason that the exterior shell proteins of Syphilis bacteria have not been well defined.<sup>39,40</sup> On the other hand, there are known antigens inside the cells., and there are antibodies that have no activity against these antigens, and there for the removal of the infection does not occur.<sup>40,41</sup>

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