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# Treatment and Control of Leishmaniasis Using Photodynamic Therapy

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## 1. Introduction

Leishmaniasis is a chronic disease affecting the skin, mucosal and/or internal organs, caused by flagellate protozoa *Leishmania* of the *Trypanosomatidae* family. [1] It is among the six most important disease in terms of its impact in public health. The world incidence of leishmaniasis is very large with about half a million new cases per year. About 12 million people are infected with *Leishmania ssp* parasites worldwide. New treatment alternatives are highly needed. Our goal here is to critically revise the literature in order to show the potential of Photodynamic Therapy in the treatment and comprehensive control of this disease. We have separated this chapter in nine sections, besides this brief introduction, which are: Leishmaniasis: Background and treatment strategies; Mechanisms in Photodynamic Therapy; Treatment of animals infected with leishmaniasis using PDT; Vector control using PDT; PDT alternatives for Blood purification; PDT on the treatment of Old World Tegumentary Leishmaniasis; PDT - *In vitro* tests in species that cause Tegumentary Leishmaniasis; Conclusions; References.

## 2. Leishmaniasis — Background and treatment strategies

There are two main forms of leishmaniasis, visceral (VL) and tegumentary (TL) leishmaniasis, which are also respectively called Kala Azar and Bauru ulcer. The later, received its name because of the original high prevalence in Bauru, a city in the countryside of the State of São

Paulo, in Brazil. The tegumentary leishmaniasis is characterized by skin lesions (cutaneous-CL) and mucocutaneous lesions (such as, nasal and mouth regions) [2].

Leishmaniasis is a common zoonosis, with domestic (dogs and cats) and wild (rodents, marsupials, edentulous and wild canids) reservoirs. It is transmitted to humans by sand flies, which comprise the genus *Lutzomyia* and *Phlebotomus*. Details of the etiology and pathophysiology of the disease are out of the scope of this chapter and we suggest that the reader consult reviews that focus on these subjects [3].

The current scenario of leishmaniasis treatment is not promising. Therapeutic approaches include systemic administrations of anti-parasitic medications, which often present serious side effects. Few drugs are available in the clinic, mainly antimonials and amphotericin, and the frequency of resistance development is rising. Therefore, there is an urgent need to establish new and more effective treatments for both VL and TL. The treatment of TL (the focus of this chapter) urges new drugs and new therapeutic forms, that allows for more effective and conveniently administered treatments [4].

One of the promising approaches, and the one discussed in here, is photodynamic therapy (PDT). The main expectation of this approach is that it treats lesions in a localized manner, without damaging healthy tissues [5]. The few reports that are available in the literature have validated this hypothesis. In addition, no sign of systemic toxicity is reported in PDT, eliminating one of the major health issues related to existing TL treatments.[6] These points will be further discussed in this chapter.

The use of light as a therapeutic modality has gained strong impulse recently due to the development of efficient and affordable light sources. Consequently, photo-activated drugs (Photosensitizers-PS) play key roles in the present clinical portfolio, and more importantly, are the major lead in the development of new drugs to treat a variety of diseases such as cancer, microbial infections and tropical diseases. However, increasing the efficiency of PDT photosensitizers remains challenging [7-9].

The use of PDT in veterinary is much less common even considering the benefits that such strategies could bring in the treatment of high-value reproducing animals, as well as, in the treatment of animals that are reservoirs of human diseases [10].

In terms of developing effective treatments against leishmaniasis in endemic areas, it is important to think of comprehensive strategies that could cause a quick decrease in the pool of infected patients (Figure 1). It is also important to emphasize that leishmaniasis is a neglected tropical disease and, therefore, it is highly relevant to consider low-cost strategies that would serve as an alternative for public medicine in poor countries [9]. Developing efficient clinical protocols that would cure/control the disease would not only favor the patient itself, but also, would decrease the chance of this infection being transmitted to others by the vectors or by blood transfusion. In the next sections, we will explain how PDT can be helpful in the treatment of patients, as well as, of all the possible reservoirs and transmitting vectors that would favor the parasite infection cycle (Figure 1). Some of this potential has been attained and some are still in the step of hypothesis testing.































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