



**Medical Analysis
Department**

Leishmania sp.

Parasitology (MA 301)

Summer School

Lecture 8

Lecturer: Mr. Omer Sardar Taha

E-mail: Omer.sardar@tiu.edu.iq

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Introduction

Leishmania are obligate intracellular parasites with two hosts: mammals and female sandflies.

- In mammals, found inside macrophages as **amastigotes** (oval, with nucleus and kinetoplast).
- In sandflies, they exist as **promastigotes** (spindle-shaped, with a single anterior flagellum).

Distribution

Leishmaniasis has an immense geographical distribution in the tropics and subtropics of the world, extending through most of the Central and South America, part of North America, Central and South-East Asia, India, China, the Mediterranean region and Africa.

Types of *Leishmania* sp.

Across the tropics, three different diseases are caused by various species of the genus *Leishmania*. These are:

1. ***Visceral leishmaniasis***: The species *Leishmania donouani* complex infecting internal organs (liver, spleen and bone marrow) of humans are the causative parasite.
2. ***Cutaneous leishmaniasis***: The species *Leishmania tropica* is the causative parasite.
3. ***Mucocutaneous leishmaniasis***: It is caused by the *Leishmania braziliensis* complex.

Morphology

Amastigote:

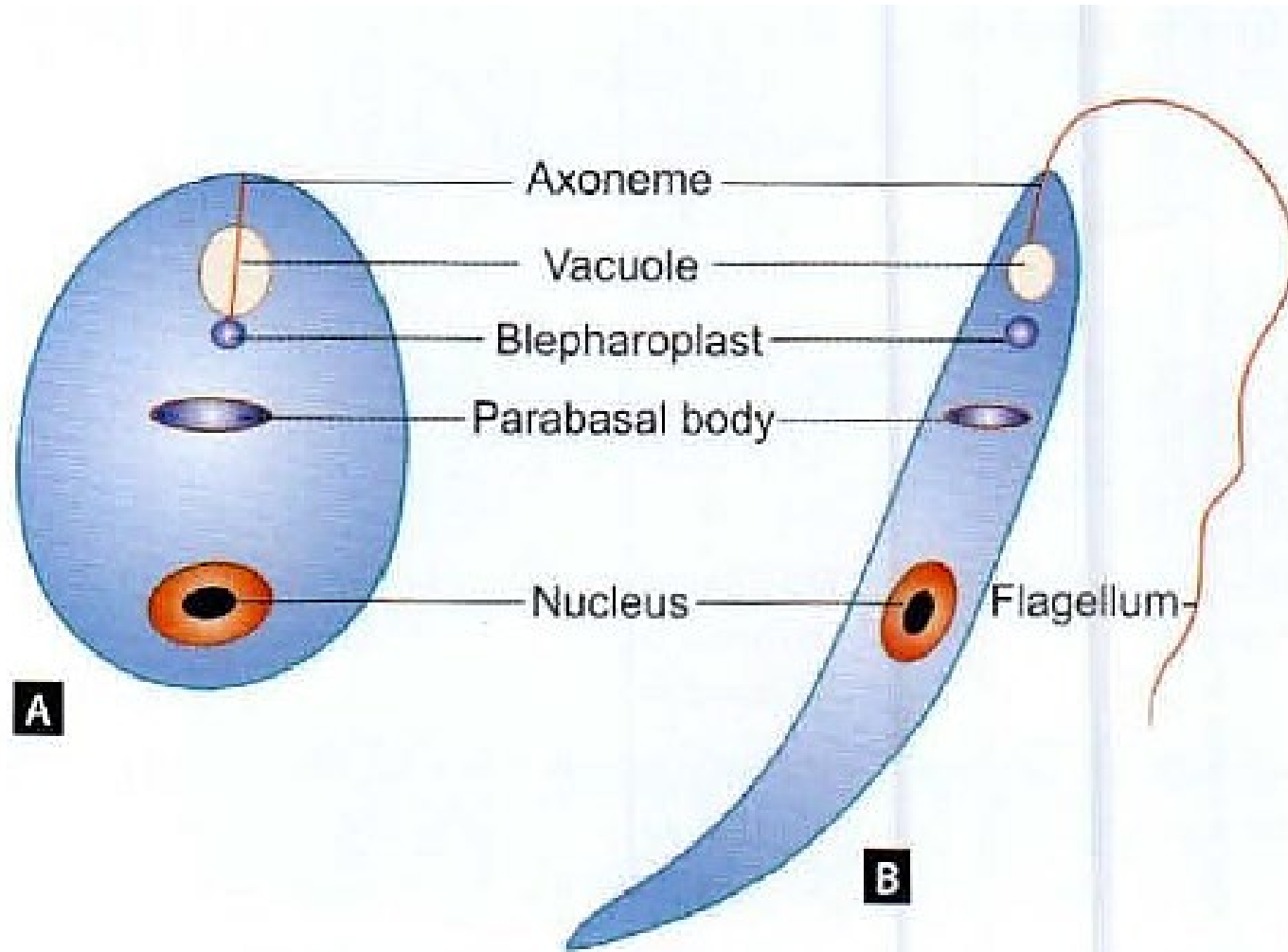
The amastigote form (LD body) is an ovoid or rounded cell, about 2-4 μm in size.

- It is typically intracellular, being found inside macrophages, monocytes, neutrophils, or endothelial cells.

Morphology

Promastigote:

- It is a flagellar stage and is present in the insect vector, sandfly, and in cultures.
- The promastigotes, which are initially short, oval, or pear-shaped forms, subsequently become long, spindle-shaped cells, 15- 25 μm in length and 1.5-3.5 μm in breadth.
- A single nucleus is situated at the center. The kinetoplast lies transversely near the anterior end.
- The flagellum is single, delicate, and measures 15-28 μm .



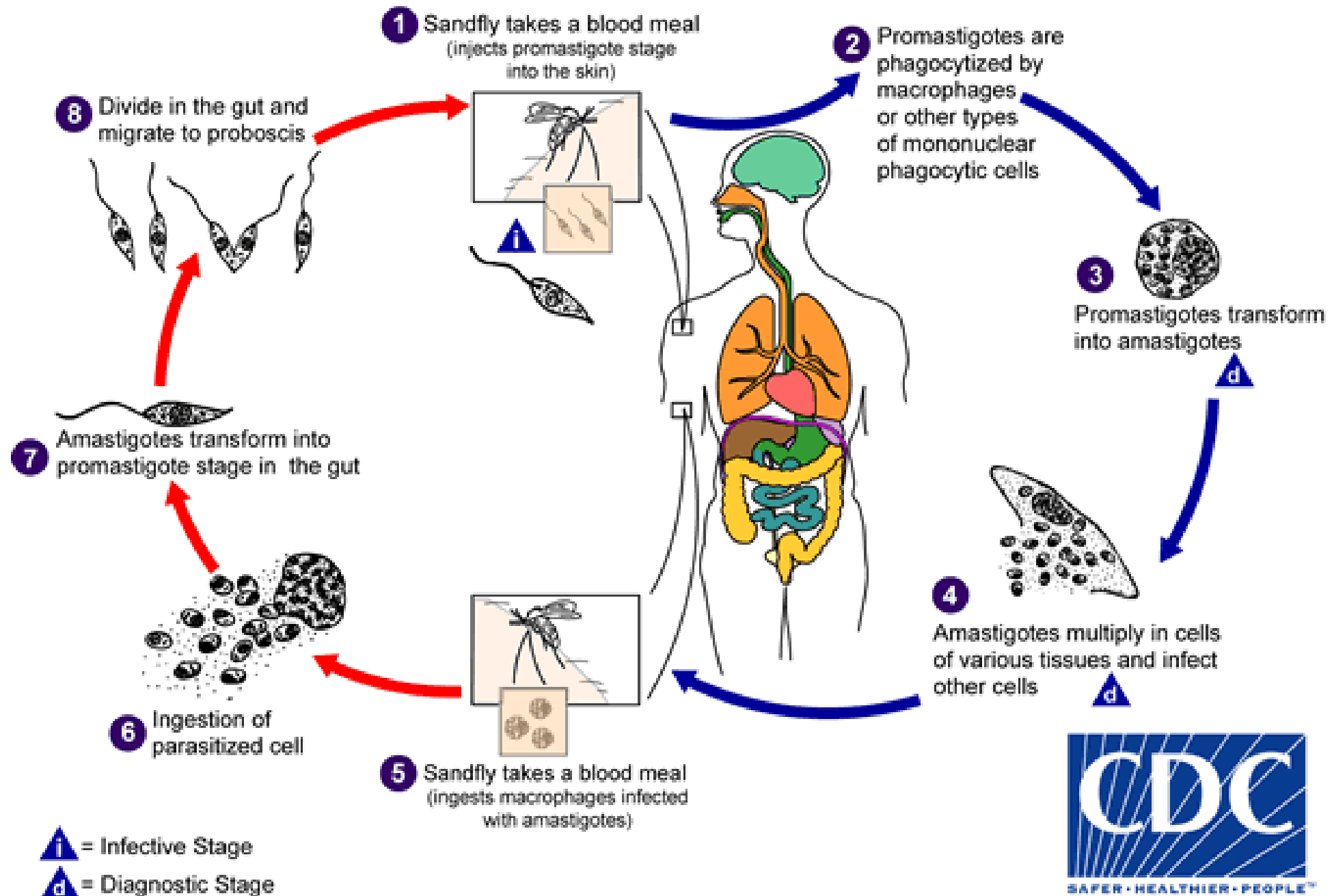
Figs 9A and B: Morphology of *Leishmania donovani*. (A) Amastigote [Leishman-Donovan (LD) body]; and (B) Promastigote

Life cycle

- Transmitted by bite of an infected female sandfly, injecting promastigotes.
- Promastigotes are taken up by macrophages and transform into amastigotes.
- Amastigotes multiply inside macrophages (each species in specific site)
- Sandfly ingests macrophages with amastigotes during a blood meal.
- In the sandfly midgut, amastigotes change back into promastigotes, multiply, and migrate to the proboscis for transmission.

Sandfly Stages

Human Stages



Leishmania donovani
(Old World Leishmaniasis)

Case Study

A 24-year-old man presented with prolonged fever, weakness, weight loss, and marked enlargement of the spleen and liver. Laboratory investigations showed anemia and other abnormalities in blood cell counts. Examination of a tissue sample revealed intracellular amastigotes of **Leishmania donovani**. He was treated with an appropriate antileishmanial medication and advised on measures to prevent sandfly exposure, leading to significant clinical improvement.

Introduction

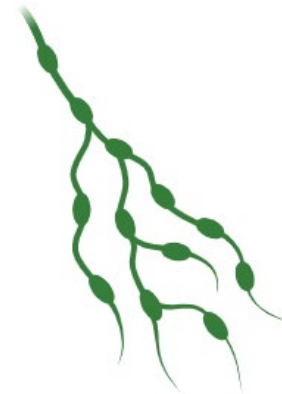
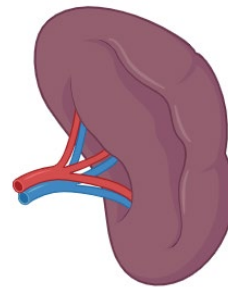
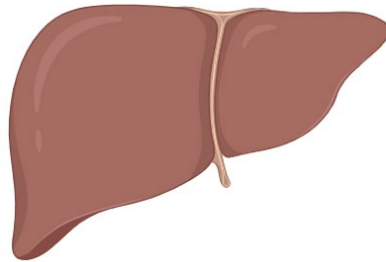
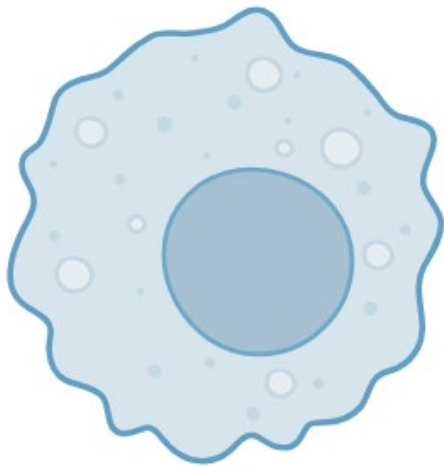
Leishmania donovani causes Visceral Leishmaniasis or ***kala-azar***.

Distribution

Visceral leishmaniasis or kala-azar is a major public health problem in many parts of the world. According to the World Health Organization (WHO), a total of 500,000 cases of VL occur every year. Of these new cases, 90% are found in the Indian subcontinent and Sudan, and Brazil.

Habitat

The amastigote (LD body) of *Leishmania donovani* is found in the reticuloendothelial system. They are found mostly within the **macrophages** in the spleen, liver, bone marrow, and less often in other locations such as skin, intestinal mucosa, and mesenteric lymph nodes.



Life cycle

Leishmania donovani completes its life cycle in two hosts

Host: Man, dog, and other mammals.

Vector: Female sandfly (*Phlebotomus* species).

Infective form: Promastigote form present in the midgut of the *female* sandfly.

Vector

Sandfly (*Phlebotomus* sp.)



Pathogenicity of *Leishmania donovani*

- Parasites invade and multiply within macrophages of the spleen, liver, and bone marrow.
- Destroys reticuloendothelial cells, anemia, hepatosplenomegaly, and immunosuppression.

Clinical Manifestations (Kala-azar / Visceral leishmaniasis):

- Prolonged irregular fever
- Hepatosplenomegaly (enlarged liver & spleen)
- Weight loss, anemia, weakness
- Darkening of skin (in chronic cases)



Diagnosis

1. Microscopical:

Demonstration of amastigotes in tissue smears (spleen, bone marrow, lymph node).



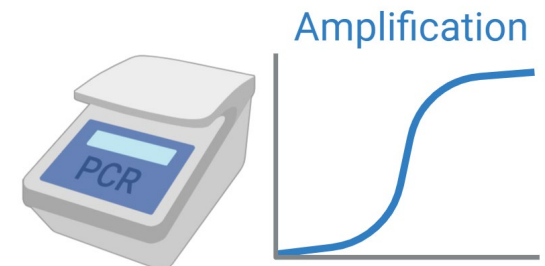
2. Serological:

rk39 rapid diagnostic test, ELISA, IFAT.



3. Molecular:

PCR (high sensitivity, confirmatory).



Treatment

Treatment of *Leishmania donovani*

- Liposomal Amphotericin B – drug of choice.
- Sodium stibogluconate (SSG) – used but resistance common.
- Paromomycin / Pentamidine – alternatives in resistant cases.

Leishmania tropica
(cutaneous Leishmaniasis)

Case study

A 26-year-old man presented with a painless skin ulcer on his exposed arm that had gradually enlarged over several weeks. He lived in an area where sandflies were common. Examination of a lesion sample revealed intracellular amastigotes consistent with **Leishmania tropica**. He received appropriate treatment for cutaneous leishmaniasis and was advised to prevent sandfly bites, leading to gradual healing of the lesion.

Introduction

causes old-world cutaneous leishmaniasis. The disease is also known as *oriental sore*, *Delhi boil*, *Bagdad boil*, or *Aleppo button*.

Distribution

L. tropica is found in the Middle East, India, Afghanistan, Eastern Mediterranean countries, and North Africa.

Habitat

L. tropica, causing CL (old world CL) is essentially a parasite of skin. The amastigote forms occur in the reticuloendothelial cells of the skin, whereas promastigote forms are seen in sand fly vector.

Life cycle

Leishmania trpoica completes its life cycle in two hosts

Definitive host: Man, dog, and other mammals.

Vector: Female sandfly (*Phlebotomus* species).

Infective form: Promastigote form present in the midgut of the *female* sandfly.

Vector

Sandfly (*Phlebotomus* sp.)



Pathogenicity of *Leishmania tropica*

- Parasites invade macrophages of the skin at the site of a sandfly bite.
- Cause localized tissue damage and chronic granulomatous inflammation.

Clinical Manifestations (Cutaneous leishmaniasis):

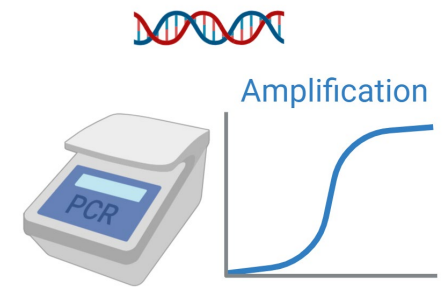
- **Oriental sore:** single or multiple skin ulcers at bite site.
- Lesion starts as a papule → enlarges → ulcerates with raised edges.
- Usually heals spontaneously but leaves a scar.



Diagnosis

Diagnosis of *Leishmania tropica* (Cutaneous leishmaniasis):

- **Microscopical:** Demonstration of **amastigotes** in skin smear or biopsy.
- **Molecular:** PCR for species confirmation.
- **Serology:** Limited value (since disease is localized).



Treatment

Treatment of *Leishmania donovani*

- Liposomal Amphotericin B – drug of choice.
- Miltefosine – effective oral alternative.
- Sodium stibogluconate (SSG) – used but resistance common.
- Paromomycin / Pentamidine – alternatives in resistant cases.

Leishmania Braziliensis
(New World Leishmaniasis)

Case Study

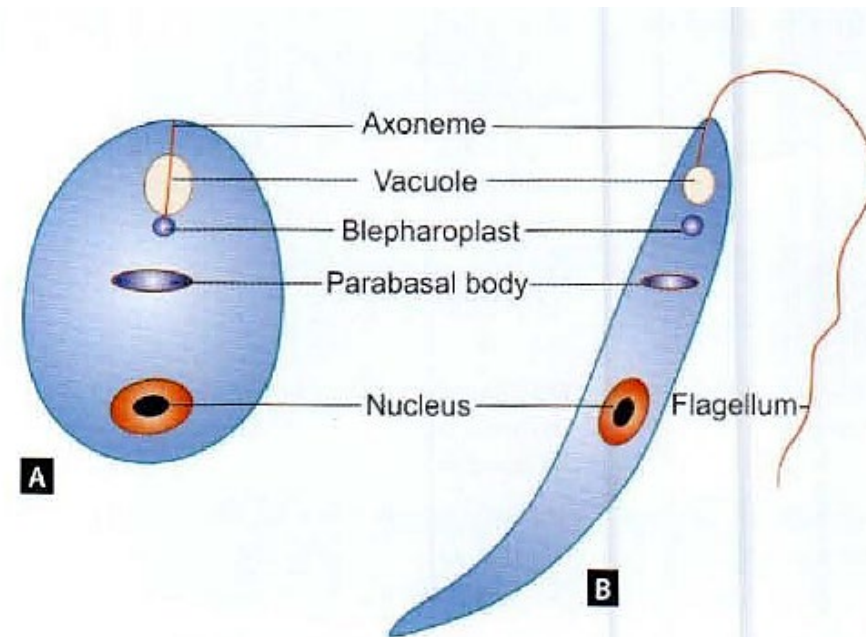
A 30-year-old man presented with a chronic skin ulcer on his leg several months after visiting a forested area where sandflies were prevalent. The lesion initially appeared as a painless skin ulcer and later developed changes involving the mucosal tissues of the nose. Examination of tissue samples demonstrated amastigotes consistent with **Leishmania braziliensis**. He received appropriate systemic treatment for mucocutaneous leishmaniasis and was advised to prevent sandfly bites, leading to clinical improvement.

Habitat

These occur as intracellular parasite. The amastigote form is seen inside the macrophages of skin and mucous membrane of the nose and buccal cavity. The promastigote form occurs in vector species *Lutzomyia*.

Morphology

Morphology of amastigote and promastigote forms of both the parasites is same as that of the other two species of *Leishmania*.



Figs 9A and B: Morphology of *Leishmania donovani*. (A) Amastigote [Leishman-Donovan (LD) body]; and (B) Promastigote

Vector

Sandfly (*Lutzomiya* sp.)



Life cycle

Leishmania braziliensis completes its life cycle in two hosts

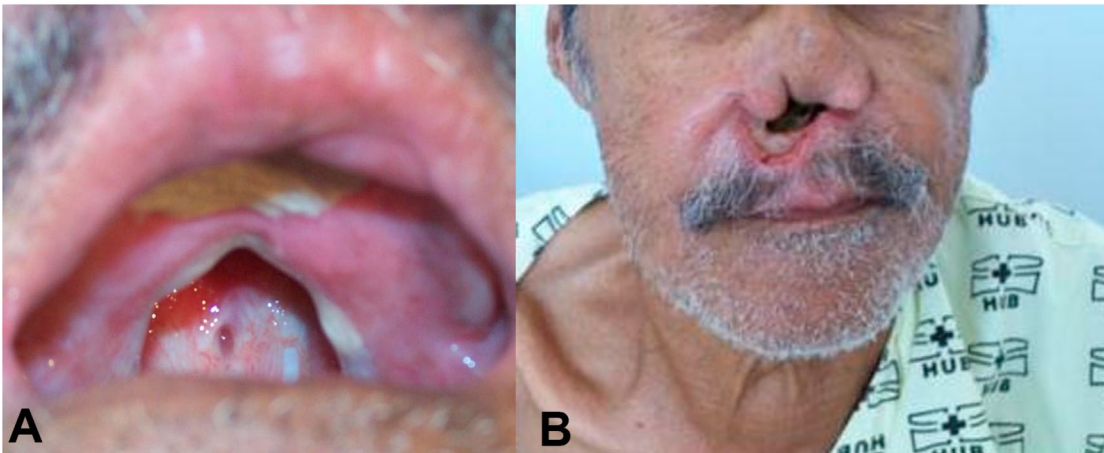
Definitive host: Man, dog, and other mammals.

Vector: Female sandfly (*Lutzomyia* species).

Infective form: Promastigote form present in the midgut of the *female* sandfly.

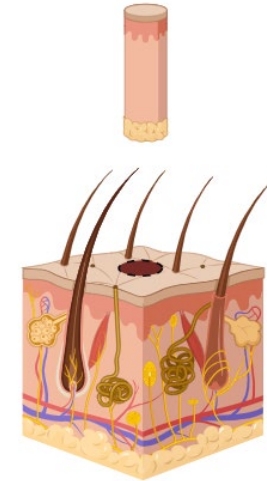
Clinical features

- Causes **mucocutaneous leishmaniasis (espundia)** and CL. Severe, destructive lesions involve nose, mouth, and larynx, nasal septum perforation, enlarged lips/nose, voice changes. Scarring and disfigurement may occur (common in Bolivia, Brazil, Peru).
- **Pian bois:** Caused by *L. braziliensis guyanensis*, presents as painless, persistent dry ulcers (“forest yaws”).



Diagnosis

- **Microscopy:** Amastigotes are demonstrated in smears taken from lesions of skin and mucous membrane.
- **Biopsy:** Amastigotes can also be demonstrated from slit-skin biopsy.
- **Serology:** ELISA is a sensitive method to detect antibody; being positive in 85% of cases.



Treatment

- **Amphotericin-B** is the best alternative drug currently available.
- In case of respiratory complications, glucocorticoids can be used.

References

- Paniker, C. K. J. & Ghosh, S. 2021. *Paniker's textbook of medical parasitology*, New Delhi, Jaypee Brothers Medical Publishers.