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Introductory Chapter: Chagas Disease and Its Global Impacts

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<http://dx.doi.org/10.5772/intechopen.77275>

1. Introduction

Soft tissue specimens from mummified remains of members of the Chinchorro culture of the Andean coast in South America have been found to be positive for *Trypanosoma cruzi* (*T. cruzi*) DNA [1]. The Chinchorros were fishermen inhabiting the pacific coastal region of northern Chile and southern Peru and *T. cruzi* the causative agent of American trypanosomiasis or Chagas disease is presently listed as one of the several neglected tropical diseases (NTDs) and as one of the five neglected parasitic infections (NPIs) of the world focused by the World Health Organization (WHO) and the Center for Disease Control (CDC) for public health intervention [2]. This finding spells out that the causative agent of American trypanosomiasis has been around for 9000 years already as the samples which tested positive are dated back to 7050 B.C. [1]. There are several historical accounts that have also mentioned about the prevalence of Chagas disease but some of these are just speculative assessments as signs and symptoms of patients were not consistent with the current pathophysiology of the disease. There were even speculations that Charles Darwin himself was infected with Chagas disease but popular opinions disagree as there were no actual clinical evidences to support that Charles Darwin was indeed suffering from megacolon or heart disease even later on in his life [3].

2. *T. cruzi*: a primeval pathogen

It was only in 1908 during an anti-malaria campaign in supporting a railway construction in the North of Minas Gerais that Carlos Chagas, a Brazilian physician (hygienist and bacteriologist) during his observations made this disease the center piece of his novel findings.

A railroad engineer acquainted him with the presence of blood sucking insects in infested houses which preferentially were biting and taking blood meals on the face of occupancies in those mud huts during their sleep [4]. He identified the protozoan parasite *T. cruzi* in the bugs' gut and later confirmed the presence in the blood samples of individuals who had a history of being bitten by this blood sucking bug. For this, scientific minds from his time to the present are indebted for the collection of knowledge he made possible in the process of understanding the disease, its agents, and its course in both human and animal hosts.

3. Transmission: a wide spectrum of dissemination modes?

Chagas disease or American trypanosomiasis is caused by a protozoan parasite *T. cruzi* mainly identified in blood samples of patients who frequently had been bitten by a triatomine bug on the face hence its namesake as kissing bugs. An estimated 8 million people in Mexico, Central and South America are infected with Chagas disease [2]. This vector borne parasitic infection is not limited to rural areas but has also been identified in urban areas. In this modern time, diaspora has been an effective vehicle in spreading this infection to different parts of the world. While other modes of infections have also been identified from ingesting contaminated food or drinks with the feces of the kissing bug [5] to blood transfusions [6], and organ transplantation [7, 8] as being incidental causes of parasite transmission.

4. Chagas disease: debilitating health impacts

Signs and symptoms of a person having Chagas disease may include fever, fatigue, malaise, and sometimes rash or edema (chagoma) around the eye during the acute phase while cardiac and intestinal complication may present in less than 50% of those infected [2]. Infections persist throughout life and most infected individuals are not even aware that they carry the parasite. To date, there is no effective drug or vaccine that has been developed and vector control is still the main driving force for the parasite intervention.

The World Health Organization Fact sheet of 2017 outlines key information about Chagas disease. Approximately 6 to 7 million people worldwide are infected (mostly in Latin America) and some scientists even place estimates as high as 20 million. About 30% of chronic infections progress to cardiac implications and 10% to digestive tract abnormalities which are irreparable [9]. Chronic infections can lead to megaesophagus, megacolon, mega-small intestine, and mega gallbladder to name a few, other impairments of the gastrointestinal tract organs and tissues have been observed. A higher incidence of *Helicobacter pylori* infection, colon, and esophageal cancer has been demonstrated in association with trypanosomiasis as well [10]. Chronic chagasic cardiopathy on the other hand leads to cardiac lesions and the patient's immune status and initial parasitemia are significant determinants of the gravity and progression to organ failure [11].

The estimated annual cost of medical care for trypanosomiasis patients in Colombia in 2008 has been estimated to be 267 million US Dollars [9]. While a computational simulation model funded by the Bill and Melinda Gates Foundation has estimated the global economic burden to 7–19 billion US Dollars per year [10] and approximately 188 billion US Dollars per lifetime [11]. These figures are higher than the estimates for other prominent global diseases (rotavirus 2.0 billion US Dollars, cervical cancer 4.7 billion US Dollars, and Lyme disease 2.5 billion US Dollars) [12]. Meanwhile, these estimated figures alone raise large red flags which the scientific community and funding agencies should focus their attention again on trypanosomiasis. Although, naturally vector borne and localized in South America, this disease has found its way into several modes of transmissions and has spread and is continuously spreading in different parts of the world.

To date, there is still no vaccine against Chagas disease. Drug intervention with antiparasitic agents is only useful during the early phase of infection. Wherein, the signs and symptoms are usually misdiagnosed for other pathologic conditions or left undiagnosed altogether and if left undetected will consequently lead to debilitating conditions and mortality. For this reason, vector control and hygienic living conditions have been and should be a constant advocacy. Vector control cost estimates have been around 5 million US Dollars for spraying insecticides which is significantly less compared to risks in human well-being and accumulated medical care bills annually and through a lifetime. Maintaining clean living conditions in a household and using bednets in sleeping areas [13] cost even less as a reasonable means of intervention from preventing kissing bug bites.

5. Concluding remarks

This book is dedicated to the millions who have fallen victims and those presently and heavily burdened with Chagas disease. The contributors of the literatures herein contained for a significant time in their lives have become living witnesses to the ravage and devastation kissing bugs carrying *T. cruzi* can inflict upon an individual as well as a nation. These investigators have dedicated their time and being in so many different ways in their own personal and consolidated effort to provide the best, most comprehensive, and up to date knowledge to explore the American trypanosomiasis in all its available entirety. The chapters contained in this book will no doubt prove to be indispensable in getting up-close and personal into Chagas disease findings. Each chapter provides in-depth discussions of each specific area of historic, biologic, vector, and pathologic, along with clinical aspects, diagnostic challenges, natural products, drugs discovery, and various control measures as well as strategies relative to this very old yet still rampant and neglected parasitic infection. It is with great anticipation that this compilation of literature reviews and researches would find its way into the hands of experts as well as those novice who will soon be at the forefront of leading the fight against this debilitating infection. It is with great hope that this book will be a tool for the fruition of Chagas disease eradication.

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