ORIGINAL ARTICLE

European Encounters with Dracunculiasis in the Northern Bank of the Persian Gulf: A Perspective from Travelogues of the Safavid and Qajar Eras

Abstract

"Dracunculus medinensis" or "Guinea worm" disease is transmitted to humans through drinking contaminated water, leading to symptoms such as ague, muscular weakness, and infection. This disease is endemic to arid and warm regions with minimal rainfall and no safe and running water access. The northern bank of the Persian Gulf is one of the regions that has always faced water shortages due to its geographical location and climatic conditions. Hence, people had to rely on stored water in reservoirs, using stagnant water for a long time. This practice contributed to the widespread prevalence of Guinea worm disease in the region until the late 20th century (1996 AD). European travelers and commercial forces faced significant challenges when contracting this non-native and unfamiliar disease; Europeans required a better understanding of the nature, treatment methods, and prevention measures associated with Guinea worm disease to maintain the health and safety of their human resources in the region; Therefore, in this research, we utilize an analytical-descriptive approach to examine travelogues and library resources, assessing the evolution of European coping strategies for this disease from the Safavid to Qajar periods. The findings of this research show that Europeans initially did not have much clinical information about this disease and relied on indigenous treatment methods. However, as their understanding of the disease's nature gradually improved, more effective preventative measures were adopted.

Key words: Dracunculiasis, Reservoir, Northern bank of the Persian Gulf, Travelogues, Water Supply, Workforce

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Introduction

"Dracunculus medinensis", also known as "Guinea worm disease" or Dracunculiasis is a type of parasitic infection (Tinsley, et al, 2016, p. 554) that affects humans and animals upon consuming contaminated water. Contaminated stagnant water is the main cause of the disease. In the northern regions of the Persian Gulf, a dry climate and minimal rainfall led to a longstanding practice of storing necessary water supplies in reservoirs. Stagnant water in these water reservoirs was the cause of Guinea worm disease, which was locally termed string disease.

In addition to the description and nature of the disease, its symptoms and treatment are mentioned in the writings of Islamic medical history and local histories. European travelogues also provide valuable insights into Guinea worm disease. The primary sources include the accounts of world travelers such as Chardin, Tavernier, Dieulafoy, and Curzon, who have documented their experiences and observations of the disease, in addition to its causes and symptoms.

Notably, a German physician named Engelbert Kaempfer dedicated three years of service to the Dutch company in Bandar Abbas, where he gathered considerable information on the nature of Guinea worm disease. His research culminated in the publication of his book, "*Amonitates exotica*", which contributed significantly to the body of knowledge on this affliction.

In Iran, only the part of this book that was related to Iran's political and social history was translated. For this research, it was necessary to consult the source material directly. Although Polak, the Austrian physician of Naseroddin's court, did not personally observe any cases of Guinea worm disease, in his book "*Persian Das Land Uad Seine Bewohner*", he documented accounts from Europeans who had encountered the disease in the northern regions of the Persian Gulf. Additionally, the Dutch physician Schlimmer, who was present in Iran during the late Qajar era, contributed to understanding the disease in his work entitled "*Terminologie Medico-Pharmaceutique et Anthropologique Française-Persane*". This book serves as a dictionary of traditional Iranian medical practices, presented alongside modern terminology. Schlimmer described the clinical nature of Guinea worm disease as a parasitic infection and outlined its symptoms and treatments.

Despite extensive research, we found no comprehensive and dedicated book focusing on the nature of Dracunculiasis and its history in Iran. Most epidemiology and regional health books mention this disease as a parasitic infection endemic to the northern and back shores of the Persian Gulf. Furthermore, no Persian articles are discovered to be specifically related to the topic of this research. Most of the articles are related to the medical history of the disease and the description and treatment of the disease.

This research tries to answer the following questions regarding the history and nature of Dracunculiasis or Guinea worm disease: Were Europeans familiar with the clinical nature of this disease? If the Europeans contracted this disease, what treatment did they use to manage it? What measures did the Europeans take to prevent this disease in the northern banks of the Persian Gulf? The responses to these questions have been derived from the European travelogues from the Safavid to Qajar eras. Moreover, a library-based approach has been used to gather relevant information on the subject. It is also hypothesized that the Europeans initially had no information about this disease and got their information from the natives. In addition, due to the lack of familiarity with the disease

and its treatment methods, almost all European patients used local treatment methods in case of illness. Contracting this disease could disrupt the number of human resources of European commercial companies on the northern banks of the Persian Gulf for a long time. The endemic nature of this disease in the northern regions of the Persian Gulf makes it essential to examine the way Europeans responded to this affliction as foreigners in the area. As a result, preventive measures for Europeans facing this disease will be investigated.

Clinical nature of Dracunculiasis (Guinea worm disease)

Guinea worm disease, also known as Dracunculiasis, is a parasitic infection. Humans get infected by the infective larva (worm) of Cyclops by drinking contaminated water. When the thin female dracunculus worm with a length of 30 cm to 1 meter reaches the skin (Figure 1), it blisters on the skin's surface. When the blister breaks open, large numbers of motile rhabtidiform Larvae are released. After entering the stagnant waters, Cyclops eats it, and the parasite's life cycle is complete (Tinsley, et al, 2016, p. 554) (Figure 2).

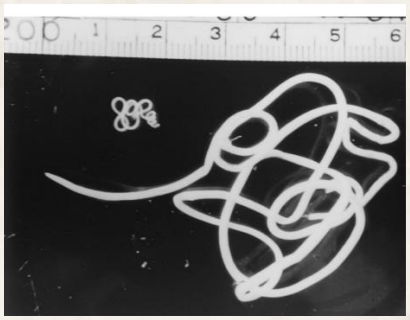

Figure 1. Comparing the length of male and female worms (*Cairncross, Muller, and Zagaria, 2002, p. 223246*)

Dracunculiasis infection (Guinea worm disease) has a latent period, and until blistering, there are either no or very few symptoms. As soon as blistering occurs, fever and symptoms of itching appear on the face and around the eyes, as well as wheezing and hives (Tinsley, et al, 2016, p. 555). The distribution of blisters is associated with an intense burning sensation, mostly blistering on the lower part of the leg and around the ankle. However, the worm can be present anywhere in the body, including the trunk, arm, hand, rump, thigh, knee joint, calf muscle, and genital area (Karam, and Tayeh, 2006, p. 377).

This disease can be cured by timely laser treatment or surgery. A significant bacterial infection at the worm's (blister) site is common when no treatment is available. In this case, the condition may worsen, such as blood infection and tetanus, and complications may arise. By entering the joints, the medinensis causes bacterial infection and swelling of the joints. Such problems may lead to physical disability and limited mobility (Karam, and Tayeh, 2006, p. 377). However, gradually removing the worm by daily wrapping a few centimeters around a piece of wood is still a common and effective way to treat this parasite. So far, no effective drug has been identified for treating dracunculiasis (Tinsley, et al, 2016, p. 555).

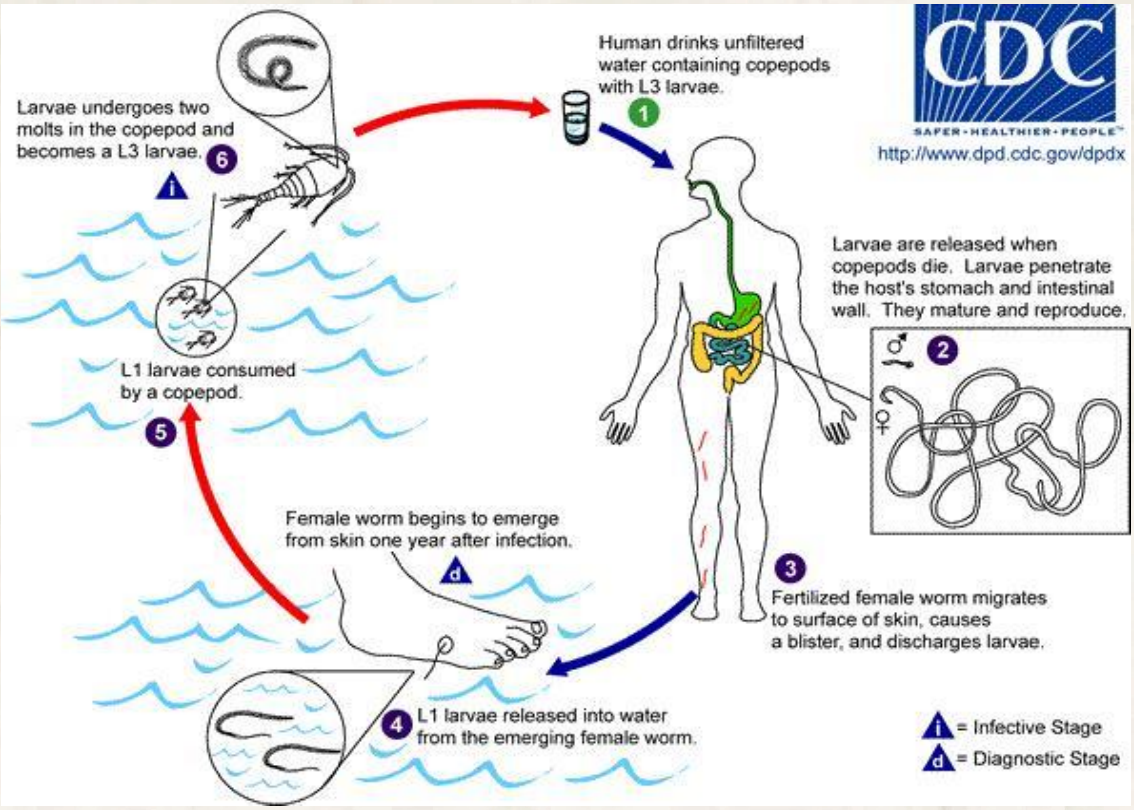

Figure 2. Parasite life cycle (*Dracunculiasis, 2024*)

Epidemiology of Dracunculus medinensis (Guinea worm disease) in Iran

As described, Guinea worm disease spreads to humans or other animals by drinking contaminated water. Water also becomes polluted when it remains stagnant for a long time. The weather is dry in the northern and back banks of the Persian Gulf, and there is very little rainfall during all seasons, so the natives have built reservoirs to store drinking water. This water storage trick is considered an innovation, but the stagnant water has caused the disease of Dracunculus medinensis to appear in this area. However, during the past centuries, reservoirs have been vital for life (Figure 3). Reservoirs are rectangular, round, domed, or conical, and they are often built with stone and Sarooj (water-resistant) mortar (Vosoughi, 2008, p. 1797). The water reservoirs of the northern bank of the Persian Gulf were engineered in a way to be in the path of rainwater because, unlike the reservoirs in the central plains of Iran, which are connected to a series of aqueducts and underground water, the southern parts of Iran do not have much underground water due to prolonged droughts and the salinity of the land; as a result, people have built almost most of the water reservoirs on the banks and back banks of the Persian Gulf near the mountain and in the direction of the rainwater flow.

The importance of water reservoirs among the people of the northern bank of the Persian Gulf is evident in Tavernier's accounts of his visit to the city of Lar: "In the city of Lar and its surroundings, there are numerous large water reservoirs, underscoring their necessity given the region's prolonged periods without rain. According to Tavernier, local residents employed an ingenious method to manage their water resources: There may be no rain for twenty-three years, and in the first days when it rains, they close the holes

in the reservoirs and prevent water from entering them. After a day of rain, they wash the dirt on the ground and then fill the reservoirs with water. Water distribution in Lar city is very regular. It seems that these reservoirs are all wine barrels. They never open more than three cisterns/ reservoirs at once; when opening them, the ruler or his trustee must be present" (Tavernier, 1670, p. 276).

Figure 3. A photo of the reservoirs in the old village in Larestan city, captured by the author. In the northern Persian Gulf, due to drought and scarce drinking water, residents depend on reservoirs. They also diligently maintain and adhere to strict hygiene protocols, including water purification and chlorination. (*Photo is taken by the author*)

In 1955 AD, the Larestan region was visited for scientific research. In this research, they found about 200 patients with parasites among the residents of 20 villages. (Figure 4)

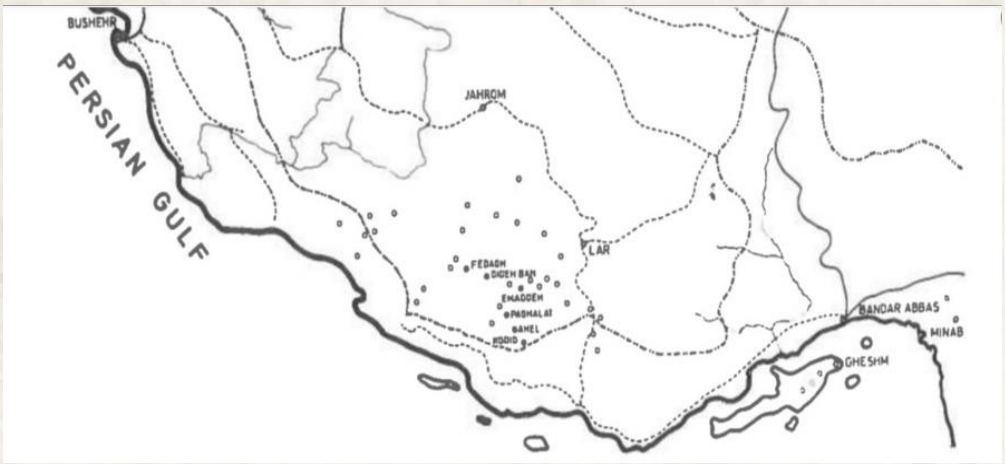

Figure 4. Distribution of Guinea worm disease in the northern coast of the Persian Gulf in 1955 (*Sahba, et al, 1973, p. 344*)

In 1955, a scientific research expedition to the Larestan region revealed approximately 200 cases of parasitic infection among residents across 20 villages. From the 20 villages surveyed in 1956, 468 patients were identified and reported. While the number of patients

varied in different villages, the average contamination rate was around 2%, ranging from 0.2% to 22%. (Sahba, et al, 1973, p. 344). Measures taken to address the health crisis focused on reducing pollution in water reservoirs through chlorination and dredging. These measures proved highly effective, leading to a significant fall in infection rates. Finally, in 1996, Iran received a certificate of elimination for this disease from the delegation of the World Health Organization (Sahba, et al, 1973, p. 344).

Dracunculiasis medinensis (Guinea worm) in Persian sources and Islamic medicine

Islamic medicine books have mentioned this disease as "*Dracunculiasis medinensis*" and "*Ergho-L-madani*" several times. (Avicenna, 1967, p. 138; Ibn Tavus, 1798, p. 166; Rhazes, 2007, p. 333). Ibn Tavus wrote that the motivation for naming this disease Dracunculiasis medinensis was the epidemic of this disease in Medina city, and he considered it one of the diseases of the Hadj journey (Ibn Tavus, 1798, p. 166). Another reason was the common infection in urban and densely populated areas that did not have running water and often consumed stagnant and polluted water.

Ibn Sina, also known as Avicenna, and Zakaria Raazi, or Rhazes, were the first to give a detailed description of the Guinea worm parasite in their works (Karam, and Tayeh, 2006, p. 377). These two thinkers attributed the source of this disease to nerve corruption, blood dryness, and hemoconcentration (Avicenna, 1967, p. 138). According to Avicenna's writings, after the skin gets acne and is pierced, something reddish-black comes out and elongates continuously. Avicenna believed that the water and vegetables may be pathogenic (Avicenna, 1967, p. 138). Rhazes, however, associated the disease with arid and unsanitary environments, positing that it was more prevalent in cities with such climates (Rhazes, 2007, p. 333).

Ancient physicians associated the onset of Guinea worm disease with bodily dryness. Therefore, as a preventive measure, they prescribed keeping the body moist by eating and bathing, as well as bloodletting to drain the rotten blood. Also, to expedite the expulsion of the parasite/ medinensis from beneath the skin, they recommended many ointments and medicines, such as Rose oil, Morel, Aloe vera & Camphor, malt/root beer, Aloe vera, Santalum, Chicory, eucalyptus / Camphor, Myrrh, fleawort, wheat, barley, fenugreek, fig and Chamomile (Avicenna, 1967, p. 138; Ibn Tavus, 1798, p. 166).

This disease is called Dracunculiasis in the banks and back banks of the Persian Gulf. This name likely derives from the parasite's strand-like appearance. In the local chronicles of the northern bank of the Persian Gulf, such as the book *on the history of Larestan* by Movarrekh Lari or Sadid Al-Saltaneh Kababi in the book of *Bandar Abbas and Khalij Fars*, "*Aalam al-Nas fi Ahwal Bandar Abbas*", they provided much information about the symptoms of the disease and the traditional treatment method employed by the local inhabitants. Sadid al-Saltaneh wrote about the medicines that were given to the patient: "Give the patient plenty of sugar syrup without additives, along with some borage tea. If the patient experiences nausea, partial healing takes place" (Sadid al-Saltaneh, 1963, p. 601). Movarrekh Lari offered a detailed account of the surgical intervention used to treat Dracunculiasis: "Lar's people treat the disease with unscientific surgery. Lari's method involved making a small incision in the skin to expose the parasite and slowly pulling the Dracunculiasis out of the body with a needle. Gradually pull it out by hand. If it does not come out in one attempt, wrap it around a matchstick, and tie it with a cloth. Then, pour onion juice after a few hours to facilitate the parasite's complete removal from the body.

It is worth mentioning that potential complications may arise from parasite extraction. That is to say, if the Dracunculiasis ruptured during extraction, it would infect the blood. In such cases, an antidote would be applied, and the parasite would be removed with a Scalpel. Although this disease often affected the patient for three months, the disease was not considered fatal" (Movarrekh Lari, 1992, p. 45). Also, Ahmad Eghtedari in the book[1] titled "*Pain, Treatment, and Medicine in the Beliefs of the People of Southern Iran*" has given another account of the treatment process: "When the Dracunculiasis is completely removed from the skin, warm ashes from the fire of the stove or brazier are applied to the wound so that the ashes cover the entire surface of the hole on the surface and within the depth of the skin. They cover the affected area with a handkerchief or a woolen cloth. After a few days, when the injured member feels a slight itch and irritation, they open the cloth and bathe the injured member to relieve the patient from Dracunculiasis" (Eghtedari, 2009, p. 28). This disease is also mentioned in literary texts.

Saadi wrote in Boostan, referring to the illness of one of the kings (Saadi, 2008, p. 64):

"It is narrated that one of the kings
wrapped around himself due to the Dracunculiasis disease,

The weakness caused by envy destroyed him
So that he envies the conditions of his subordinates"

Interestingly, Dracunculiasis can be found in Ferdowsi's Shahnameh, as analyzed in the article "Zahhāk-e Mārdoush" (Dracunculus medinensis) in Ferdowsi's Shahnameh (The first historical report of getting infected with Dracunculus medinensis)". The author holds that Ferdowsi mentioned the name of this disease in the story of Zahhak. He has concluded that the snakes on Zahak's shoulders result from Dracunculus medinensis Guinea worm disease. Ferdowsi has depicted the parasites as snakes representing the demonic characterization of Zahhak, merging physical ailment with mythological elements. In the belief of ancient Iranians, this snake is the symbol of a demon; that is, Zahak was not only suffering from a physical illness, but people have taken a mythological aspect of his illness (Jahanshahi Afshar and Samimi, 2012, p. 171). In religious texts, they have written some points about this disease. Tabarsi, in his book *Makarem al-Akhlaq*, mentioned a prayer to be recited when removing medinensis and applying ointment to the itch (Ibn Tabarsi, 1976, p. 318). Also, in

1- Ahmad Eghtedari's book, "*Pain, Treatment and Medicine in the Beliefs of the People Living in the South of Iran*", discusses the measures taken to enhance drinking water quality in the northern and southern regions of the Persian Gulf. However, in the interest of brevity, we have summarized it in this section: "After the Second World War between 1941 and 1946, the American government, based on an apparently benevolent plan, established the Point Program, also known as Point Program Aid, to support regions impacted by political, military, and wartime conflicts. Following Iran's military occupation by Allied forces in August 1941, the Point Program organization was created to assist the Iranian population.

The delegation of the Point Program headed by Mr. Jamshid Amouzegar entered the city of Lar and visited the city's water reservoirs and its suburbs. Moreover, he pointed out that rainwater stored in reservoirs remained stagnant for years and gradually became polluted, leading to the presence of tiny red particles carrying Dracunculiasis. Since the residents had no other drinking sources, they had to consume this contaminated water. Thus, people got exposed to Dracunculiasis. And these particles must be destroyed so they do not carry the disease "Dracunculus medinensis". Then, they realized that one way to combat the spread of Dracunculiasis was importing a large amount of pond fish called Gambusia fish from different parts of Iran to Larestan, and releasing them in the reservoirs. Pond fish swallowed the carrier particles of Dracunculus medinensis, reducing the prevalence of Dracunculus medinensis. This initiative, which the Jamshid Amouzegar Board implemented at the expense of the Point Program organization, resulted in a notable reduction in Dracunculiasis cases among the local population " (Eghtedari, 2009, p. 31).

Bihar al-Anwar, Majlesi offers a healing method to cure the disease: one should wrap a woolen thread around the blister, tie seven knots on it, and recite Surah Hamd three times on each knot, followed by a specific prayer recited three times (Majlesi, 1982, p. 72).

Dracunculus medinensis (Guinea worm disease) in European travelogues

Since the 15th century, maritime transportation developed in Europe. In line with this, the transactions of international business companies began with the aim of colonizing non-European countries for economic gain. This endeavor was characterized by fervent competition between European powers, prompting frequent expeditions to the northern shores of the Persian Gulf.

With this process, after the Portuguese occupation of Hormuz, the influence of European governments in the Persian Gulf increased. In this competition, Britain, Holland, France, Germany, Russia, and other European countries tried hard to dominate this area and have economic-political influence. Of course, they encountered numerous obstacles in achieving this goal. Among them were various health issues and the endemic diseases of the Persian Gulf's northern bank, which threatened the European presence and aspirations in the region.

The travelogues that Europeans wrote after visiting the northern banks of the Persian Gulf detailed their encounters with various diseases prevalent in these areas. At first, these diseases attracted the attention of Europeans, the most common of which were heatstroke, various types of fevers caused by heat, and malaria. In the meantime, travelers were often afflicted with the disease mainly due to the clinical nature of the disease and their reliance on contaminated water sources during their stays. This issue was not extensively covered in the author's travelogues about the regions along the northern shores and back-shores of the Persian Gulf. Travelers who stayed in these areas for some time suffered from this disease and heard or wrote about it. European travelers first entered the northern bank of the Persian Gulf as religious missionaries. Then, gradually, with the expansion of sea routes and the development of maritime trade routes, the arrival of world travelers and European merchants increased. Tourists and Globe trotters left numerous writings and travelogues. However, since most travelers were merchants/businessmen, these travelogues provided little information about the social life and public health of the northern bank of the Persian Gulf. Instead, they often wrote about the political-economic situation of Iran and the Persian Gulf. However, due to economic competition among European governments, the presence of tourists led to the activity of commercial companies and attempts to influence economic-political influence in these areas. As a result, in the Safavid era, Britain and then the Netherlands were given the right to trade, and these two governments established facilities in Bandar Abbas and Khark, further increasing the presence of the European workforce. Therefore, commercial companies played an important role in the long-term stay of European travel writers in this area, contributing to the documentation of encounters with Dracunculus medinensis in the region.

Dirk Van der Cruysse, a researcher in the field of travelogues, studied the manuscripts in addition to those of Jean Chardin. Chardin visited the northern banks and back banks of the Persian Gulf during the era of Shah Abbas II (1084 BC). Chardin compiled his notes in a book called *Chardin and Iran*. He mentioned the following in this book:

"*I traveled to the village of Banaruiyeh* (*a village in Jahrom*). *This place is famous for its wells and reservoirs. He noted that tiny red insects contaminated the water in summer.*

The natives believed that if someone swallowed the larvae in contaminated water, worms would appear in her/ his body and nest under the skin. The length of this worm could grow up to one and a half meters in length and emerge from the skin, resembling a fungus. Its head and tail are unrecognizable. However, it emerges from the skin. The natives told the Europeans that this worm should be gradually removed from the body. Then, wrap it in a thin stick and avoid cutting it because, as the natives held, any remaining worm fragments within the body could cause severe infections, potentially leading to fatal consequences" (Van der Cruysse, 2001, p. 266).

Chardin's writings show that although he was unfamiliar with this disease, the natives of the Persian Gulf's northern shores had considerable knowledge about the disease and its cycle. They were aware of the fact that water reservoirs were the cause of disease and infection. Nevertheless, in all the northern banks of the Persian Gulf, from Bushehr to Hormozgan and its back banks leading to the Zagros Heights, the primary method of drinking water collection was the construction and maintenance of water storage. As Jean-Baptiste Tavernier wrote in his visit to the Larestan region, referring to the importance of water in this region: "Although the water in their reservoirs was contaminated and dirty, it was very valuable in that country, and as the water rested in these reservoirs for several years, it became rotten and leaves worms. Whenever they strained it with thin cloths and boiled it if they looked closely, they could see tiny particles that were the eggs of the same worms. The consumption of this water was believed to contribute to the development of long worms in the legs and knees of the local population. (Tavernier, 1670, p. 278).

Tavernier's extended stay in these areas resulted in more detailed observations. There are two noteworthy points in these writings. First, water contaminated with parasites was responsible for the disease, even after the native people tried to reduce water contamination by boiling water and filtering it through a cloth. Second, in the absence of drinking water as a result of the arid climate, i.e., minimal annual rainfall, the lack of underground water due to the salinity of the soil, and the proximity to the sea, the indigenous people were forced to rely on water reservoirs despite the risk of contamination.

Accordingly, it is evident that the Europeans who stayed on the northern bank of the Persian Gulf during the Safavid period (15th and 16th centuries A.D.) did not know about the nature of Guinea worm disease. Instead, they relied on the knowledge of local inhabitants to describe the disease; Kaempfer, a German physician who was present on the northern bank of the Persian Gulf during the Safavid era, investigated the clinical nature of the disease for the first time. Kaempfer provided a detailed and complete description of this disease in the book "*Amonitates Exotica*". His brief knowledge of Arabic and Persian enabled him to dispute Avicenna's classification of "Dracunculus" as a nerve disorder. Kaempfer held that "Dracunculus" was a kind of worm. He was able to examine this parasite with a microscope (Kaempfer, 1712, p. 525).

In fact, as Europeans had little knowledge of this disease, there is a noticeable absence of information about Guinea worm disease in the travelogues of the Afshariya and Zandiye periods. This lack of documentation can be attributed to the lack of political security in the plateau of Iran. Hence, the Europeans could not stay in this region long enough with the fear of contracting the illness by drinking contaminated water. However, after several years, when European travelers returned to the northern bank of the Persian Gulf, their travelogues reflected their growing awareness about the nature of this disease. As mentioned in the travelogues of the Qajar era, this disease and its clinical symptoms became

more widespread among European visitors to the region.

Madam Dieulafoy, Jane. M. wrote her memoirs when she arrived in Bushehr: "Everyone warned us not to drink this city's water because of its poisonous nature and the presence of Guinea worm larvae. She described if the larva entered the stomach, it would quickly grow and develop. Moreover, it would travel through the muscles, causing severe pain, and finally, it would appear on the skin" (Dieulafoy, 1887, p. 515). In contrast, Polak, the court physician of Naseeruddin Shah Qajar, had limited information about this disease. Accordingly, as his observation was restricted to the remains of the parasite and healing blisters, he stated that Guinea worm disease appeared to be confined to specific regions of the country. (Polak, 1976, p. 316).

Dealing with Dracunculus medinensis (Guinea worm) disease from the perspective of European travelogues

This disease was inevitable among European tourists and commercial companies in the northern and back banks of the Persian Gulf, particularly those who consumed local water reservoirs. Tavernier reported that he contracted this disease during his trip to the Larestan region: "I was also infected with Dracunculus medinensis disease on my fifth trip when I got one two and a half (three meters) long above my left leg and a one-half meter long above my right ankle" (Tavernier, 1670, p. 279). When Europeans encountered this disease, they turned to traditional and indigenous methods due to the expertise of local practitioners in dealing with the disease. Sadid Al-Saltaneh noted that barbers in the region were skillful in splitting the skin and removing the warm easily" (Sadid Al-Saltaneh, 1963, p. 601). "The Europeans had to rely on the skill of the local surgeons because they could not find an alternative to the traditional methods practiced by indigenous communities. Madame Jane M. Dieulafoy, while acknowledging the treatment of this disease by the natives of the northern bank of the Persian Gulf, wrote: "The treatment of the disease among native populations in the Persian Gulf region was relatively straightforward but required a significant amount of patience. As soon as the worm was visible in the body, the skin was split, and its head was attached to a reel with a pin. Every day, they turned the spool a little so that it would wrap around it, and thus, after a while, it would come out of the body" (Dieulafoy, 1887, p. 516). Europeans' understanding of Guinea worm disease significantly increased when they learned about indigenous medicine practiced on the northern bank of the Persian Gulf. By observing and using the information of the natives, Kaempfer found that this disease occurred in tropical areas with unfavorable weather where people drank water from contaminated reservoirs. He emphasized that "the disease was largely absent in mountainous areas where people relied on spring water " (Kaempfer, 1712, p. 534). Although Kaempfer's observations were initially speculative, subsequent European travelers confirmed his speculation as the leading cause of the disease.

Curzon wrote about the link between contaminated water reservoirs and the prevalence of Guinea worm disease: "Years ago in Bushehr, one of the merchants built a large cistern/ reservoir to collect rainwater for public use in April and May. However, it was later found that it was infected with Dracunculus medinensis" (Curzon, 1994, p. 286).

In line with the research of European physicians, Schlimmer, a Dutch physician, and scientist at the Darolfonoon Institute, encountered patients who had succumbed to the disease and also observed the traditional healing practices employed by native communities.

By removing all the worm/medinensis from the body, they put ointment on the wound

to aid in the healing process. According to Schlimmer's statement, this therapeutic process comprises hemp, potato leaves, and camphor (Schlimmer, 1874, p. 209). However, despite the Europeans' knowledge of traditional medicine methods and medicinal and therapeutic substances, the disease was still common in these areas. Dieulafoy wrote about this: "Unfortunately, in Bushehr, a person could contract the disease several times" (Dieulafoy, 1887, p. 516). Dr. Polak also mentioned that this disease could be prevented by purifying water reservoirs. He also confirmed the effectiveness of native surgical techniques in treating the disease, as exemplified by the case of Dr. Fagrin, a Swedish physician: "Dr. Fagrin, a Swedish physician who was suffering from Dracunculus medinensis, overcame the disease through painful native surgery. It was stated that as this worm/medinensis entered the body by consuming the stagnant water in reservoirs, water purification would somewhat reduce disease. However, Dracunculus medinensis was more observed in soldiers than in officers who took more precautions. " (Polak, 1976, p. 316).

Based on the mentioned travelogues and writings of people like Tavernier, Diolafova, Kaempfer, Julak, and Curzon, who stayed in the Persian Gulf for some time, raised questions about the challenges faced by indigenous populations in preventing the disease: why did the native people of these areas continue to struggle with the disease despite their knowledge of its nature and prevention and why did they continue to build water reservoirs. To address these questions, one may attribute the construction of water reservoirs to the necessity of water storage in arid regions with limited rainfall. However, as Tavernier pointed out and Polak rewrote, proper water treatment could reduce disease incidence. Until the end of the Qajar era, drinking water remained a persistent challenge for communities along the northern shores of the Persian Gulf. Contrary to the expectation, with the advancement of medical science and the arrival of new European methods to Iran during the Qajar era, and with the arrival of commercial and oil companies in the Persian Gulf, no significant change was observed in the condition of this disease. Traditional treatment methods were still in practice, and the transition from indigenous medicine to Western medicine did not entirely replace native treatments. Given these circumstances, Europeans in the Persian Gulf increasingly recognized the importance of focusing on preventive measures to address Guinea worm disease.

When a non-native person enters a new geographical area, they are usually vulnerable in terms of personal health and immunity to native diseases compared to the indigenous people of that area. The mortality of Europeans in the early years of their presence in these areas was very high. Although there are no statistics on the rate and type of their deaths, unofficial data show that the death rate was at least 25% or more. (Laurence, 2014, p. 354). It was very difficult for the European trading companies to maintain the life of human forces on the northern bank of the Persian Gulf. Initially, the impact of these diseases on European mortality was not widely recognized. Cyril Elgood notes: "The representative office of the East India Company in Iran did not have a regular medical organization in the first few years of its establishment" (Elgood, 2007, p. 441). However, with the epidemic and the increase in fevers and diseases, each European company started several health and treatment measures in the northern bank of the Persian Gulf to maintain their economic and political interests. Such measures included establishing clinics, deploying European physicians to regional companies, and expediting the delivery of necessary medical equipment and medicines. In the Persian Gulf, they carried out preventive measures, such as quarantine and vaccination policies as well as efforts to control

malaria. Therefore, the legations were obliged to monitor travelers who traveled between the Persian Gulf and India and other territories to prevent the spread of infectious diseases in their territory. These efforts helped reduce transportation bottlenecks for commercial ships, which were frequently held up in ports for health inspections (Boroumand, 2002, p. 269).

Europeans gradually prevented Dracunculus medinensis disease. For this purpose, the Europeans prohibited their human forces from drinking the water consumed by the natives of these areas. Therefore, they were able to prevent the occurrence and progress of this disease. Based on Dieulafoy's writings in the Qajar era: "Europeans bring drinking water from Basra or Muhammara in double-decker boats. But poor and needy people who used this contaminated water suffered from this disease almost all their lives" (Dieulafoy, 1887, p. 517).

Concerning the poor condition of Bushehr's drinking water, the British diplomat Lorimer stated: "The quality of Bushehr urban water was very poor. Almost all houses had wells but the extracted water was bitter. Only about 10% of the houses had water tanks. The affluent residents of the city obtained their drinking water from Bahmani, Ondor Bondor, Dehmiro, and Bujikdan or Ghonjeshkdan areas. The mentioned areas were located at a significant distance from the city. However, this water was slightly saline and unsuitable for consumption, except for those who were accustomed to its taste". Lorimer added that the water obtained from any source or place in the Bushehr peninsula was not suitable for human consumption. This point was announced by the governments of India, East India, and Britain after the chemical analysis of Bushehr's drinking water. Recognizing the poor quality of local water sources, the British embassy opted to import drinking water for its employees from Basra via R.I.M ships. (Lorimer, 2015, p. 58)

The retelling of Lorimer's writings regarding the poor condition of Bushehr at the end of the Qajar period underscores the importance of preventive measures taken by Europeans to avoid water contamination. Although this operation entailed costs for the Europeans, it was very effective in maintaining their influence and economic dominance over the Persian Gulf. In addition to water treatment efforts, Europeans pursued other preventive measures to protect their interests. Yet, no efforts were made to improve the conditions of the indigenous people of these areas by the central government or local authorities. Essential sanitary measures, such as chlorination, lining of water reservoirs, and construction of sewage facilities, were carried out at a slow pace and primarily took place during subsequent years.

Conclusion

Guinea worm disease, or Dracunculus medinensis or Dracunculiasis, is an endemic parasitic infection in tropical regions with little rainfall. In the past few hundred years, this disease has been particularly widespread in the northern and back banks of the Persian Gulf. Europeans who resided in the region have faced this disease, regarding this as a severe health concern. At first, Europeans barely had any information about its nature, infection, transmission, and treatment methods.

In the travelogues of the Safavid era, this disease was referenced using various terms, including "Dracunculus medinensis", "Dracunculiasis", and "Filariasis medinensis". These names stem from Islamic medicine or traditional practices. Initially, Europeans were unfamiliar with this disease and lacked enough information about its characteristics.

However, they soon began to clinically examine this disease and prevent it by using local information, and Islamic books, conducting observations, and performing successive tests. Despite their growing understanding of the disease, Europeans continued to use traditional methods and local surgeries for treatment. Until this century, local treatment methods were regarded as the most suitable method for treating Dracunculiasis, highlighting the importance of preventive measures in combating the disease. At this stage, Europeans did not drink polluted water. Instead, they brought clean water from other areas, such as Basra, to their facilities in the Persian Gulf. However, having examined the available sources and travelogues, we realized that neither European companies nor the Iranian government took significant measures to eradicate this disease until the end of the Qajar period. European companies did not take any measures to prevent this disease because compared to other common diseases in the Persian Gulf, such as malaria, cholera, and plague, Guinea worm disease had a lower mortality rate and a slower transmission speed. Therefore, addressing the health concerns caused by Guinea worm disease was given lower priority in comparison to other pressing public health challenges.

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