

## PLAGUE OUTBREAK IN TOBRUK, LIBYA

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### ABSTRACT

Plague is not ended even in developed countries. There have been many outbreaks around the world right up to the present time. The disease is introduced by infected rats, transported to humans by rat fleas. Tobruk is semiarid area, usually rainfall in winter is from 65 to 120 mm. In 2009, increased winter precipitation to 220 mm, enhanced small mammal food resource productivity (plants and herbs), leading to an increase in the abundance of plague hosts. Moisture may act to promote fleas survival and reproduction, also enhancing plague transmission. The study included 16 villages and 5 districts Tobruk city. Suspected cases were admitted to Tobruk Medical Centre, clinically and laboratory diagnosed, and treated with antibiotics. The outbreak of plague started from March to July, 138 persons were struck down by the infection with *Yersinia pestis*, of whom 6 cases (4.35%) died.

**KEY WORDS:** Plague outbreak, *Yersinia pestis*, Rodent-borne disease, Vector-borne disease, transmission.

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### INTRODUCTION

Plague is a rodent-associated, flea-borne zoonosis that persists throughout Africa, Asia and America as a threat of public health. It results from infection by *Yersinia pestis*, a non-motile bacterium that can live both inside and outside of cells of the infected individual, replicate in the blood, lymphoid system, reticuloendothelial system of susceptible hosts and is spread to other animals most commonly through an infected flea<sup>(1)</sup>. *Yersinia pestis* causes a disease occurring principally in rodents and fleas, and occasionally in non-rodent mammals including domestic cats and humans<sup>(2)</sup>.

Most cases of plague in people occur through exposure to wild rodent flea bites. Direct contact with blood, saliva, feces, urine, draining abscesses, or tissues from plague infected animals into open cuts or mucous membranes can cause infections in people<sup>(3)</sup>. A report of human infections through the consumption of an infected animal does exist. In this case, 4 people in Saudi Arabia become infected after eating raw liver from an infected camel and 1 person developed the buboes form of plague after slaughtering the animal and handling the meat<sup>(4)</sup>. In recent decades, the majority of human plague cases (caused by *Yersinia pestis*) have been reported from Africa, in Uganda<sup>(5)</sup>, Tanzania<sup>(6)</sup>, from Asia, in India<sup>(7)</sup>, California<sup>(8)</sup>, Mozambique<sup>(9)</sup>, from Americas, in New-Mexico<sup>(10)</sup>, and from Algeria<sup>(11)</sup>. Majority of outbreaks occur in Africa, according to WHO<sup>(12)</sup>.

### MATERIALS AND METHODS

The study was conducted in Tobruk province in the North eastern region of Libya. The province is located from 32°5'46'' to 31°5'15'' North latitude and 23° 55'1'' to 23° 58' 35'' East longitudes. The region has four seasons; Summer season (dry) from June through August, Autumn season from September through November, Winter season (rainy) from December through February, and Spring season from March through May.

The average rainfall in winter is about 95 mm, and the monthly average temperature ranges from 12°C in January to 37°C in July. Humidity level reaches 85% in summer. In 2009, the average rainfall in Tobruk was 135 mm in winter by local meteorological station. The region is semiarid area, with an average altitude being 5-70 m above sea level. The majority of people raising sheep and goats, which is the major economic activity. The study included 16 villages in rural areas and 6 districts in urban areas in Tobruk (with a total population of ~ 260,000). Data on human plague cases, reported between June and August 2009, were obtained from Tobruk Medical centre records. A total of 223 clinically suspected bubonic plague cases are diagnosed and treated, out of them 138 are positive. Diagnosis is based on clinical manifestations including typical buboes occurring in the groin, axilla or cervical nodes, fever, chills, headache, cough and malaise. All cases are diagnosed by microscopic observations of bipolar staining, Gram-negative coccobacilli. Bacteriological culturing and isolation of *Yersinia pestis* and antibody test for a plague F1- antigen were performed for a number of suspected cases. The plague was confirmed as the causative agent. The geographic distribution of plague patients was visualized by using a simplified map of villages and districts.

### RESULTS

In 2009, an outbreak of plague emerged in Tobruk province in the North eastern region of Libya. During the period from June to August, 223 suspected cases were admitted to the department of infectious diseases in Tobruk Medical Centre, reported, clinically and laboratory diagnosed and treated with antibiotics, of whom 138 laboratory confirmed cases of plague, out of them 6 cases (4.35%) died (table 1).

**(Table 1)** Results of bacteriology testing for *Yersinia pestis*, Tobruk, Libya.

<b>Total suspected cases</b>	<b>223</b>
Laboratory-confirmed cases	138 (61.9%)
<b>Bacteriology</b>	
Number tested	223
Number positive	138 (61.9%)
Number negative	85 (38.1%)
<b>F1 antigen ELIZA</b>	
Number tested	194
Number positive	138 (71.13%)
Number negative	56 (28.87%)

The highest peak of confirmed cases was in June 73 (55.99%) and died cases 4(66.7%), while the lowest confirmed cases was in august 14(10.2%) and died cases was zero (table 2).

**(Table 2)** Results of suspected and confirmed cases by months.

	June %	July %	August %	Total
Suspected cases	110 (49.33%)	86 (38.57%)	27 (12.1%)	223
Confirmed cases	73 (52.9%)	51 (36.9%)	14 (10.2%)	138
Died cases	4 (66.7%)	2 (33.3%)	0	6

Settlers and working groups were treated by Doxycycline for 7 days. The age distribution of infected patients is shown in (table 3).

**(Table 3)** Sex and age group distribution of infected cases with *Yersinia pestis*.

Age group (years)	Males	Females	Total (%)
1-10	11	07	18 (13.04%)
11-20	26	21	47 (34.06%)
21-30	17	16	33 (23.91%)
31-40	12	09	21 (15.22%)
41-50	06	06	12 (8.7%)
51-60	02	02	04 (2.9%)
61-70	02	02	04 (2.9%)
71-80	01	0	01 (0.73%)
Total	77	61	138 (100.0%)

There were 77 (55.8%) infected males and 61 (44.2%) infected females. The ratio of males to females was 1.26:1.00. The proportion of infected males (55.8%) was significantly higher than infected females (p= 0.007). The median age of patients was 40 years, and (86.2%) of patients were <40 years old. The highest incidence of infection was in age group (11-20) years old 47 cases (34.06%), followed by age group (21-30) years old 33 cases (23.91%), and age group (31-40) years old 21 cases (15.22%), while in old age group (71-80) years old was very low 1 case (0.73%), followed by (51-60) and (61-70) years old 4 cases (2.9%) respectively.

The incidence of infection was high in Attarsha 29 cases (21.02%), followed by Algara 26 cases (10.84%), Kambot 13 cases (9.42%), Azafrana and Alwatr 10 cases (7.25%) each. While, the lowest

was in marsa Lik, Belkhatir and haiy Azhoor 1 case (0.73%) followed by Gabis, Algrdba, Almrasses, Bab Darna, shara Falasteen and Haiy Almanara 2 cases (1.45%) each respectively (table 4).

**(Table 4)** The distribution of plague outbreak in the rural and urban areas.

Rural areas	Males	Females	Total (%)
Attarsha	15	14	29 (21.02%)
Albatrona	4	3	7 (5.07%)
Algara	14	12	26 (18.84%)
Azafrana	5	5	10 (7.25%)
Kambot	7	6	13 (9.42%)
Alwatr	5	5	10 (7.25%)
Ber Alashheb	3	2	5 (3.62%)
Hafallis	3	2	6 (4.35%)
Bab Azetoon	4	2	6 (4.35%)
Alkhwer	3	1	4 (2.9%)
Gabis	1	1	2 (1.45%)
Marsa Lik	1	0	1 (0.73%)
Ain Alghazala	3	2	5 (3.62%)
Algrdba	2	0	2 (1.45%)
Belkhatir	1	0	1 (0.73%)
Almrasses	1	1	2 (1.45%)
<b>Urban areas</b>			
Bab Darna	1	1	2 (1.45%)
Shara Falasteen	2	0	2 (1.45%)
Haiy Almanara	1	1	2 (1.45%)
Haiy Azhoor	0	1	1 (0.73%)
Jbelt Anoor	1	2	3 (2.17%)
<b>Total</b>	<b>77 (55.8%)</b>	<b>61 (44.2%)</b>	<b>138 (100.0%)</b>

The sixteen rural areas and five urban areas were affected in Tobruk. All settlers were treated by Antibiotics. Doxycycline for adults and Ciprofloxacin for children (figure 1).



**(Figure 1)** Map of the distribution of an infected area with the plague in Tobruk

The total number of infected patients was 138 cases of bubonic plague.

Treatment of patients was done for adults by Doxycycline, 100 mg orally twice/day and Ciprofloxacin, 500 mg orally twice/day. For children Doxycycline <45 kg, 2.2 mg/kg orally twice/day and Ciprofloxacin, 20 mg/kg orally twice/day.

### DISCUSSION

One hundred and thirty eight cases of human plague were re-emerged in 20-09 in 16 villages and 4 districts in Tobruk after two decades of silence. In fact *Y. pestis* have been maintained and circulating at low level in the rodent populations since tens of decades. Increased rainfall in winter in semiarid region results in an increase ecosystem productivity (vegetables and fruits), food resources for mammals specially rodents, leading to high breeding and increasing their population and increasing flea reproduction.

Last plague cases in Libya was reported in 1984. Re-importation of plague may be by sea transportation, or reactivation of the *Y. pestis* in Tobruk which was dormant for 2 decades. People may get the plague when they are bitten by infected fleas. Some missed cases have symptoms of infection which similar to the plague treated without having blood samples to make sure they are infected or not. Human come into direct contact with rodent fleas or through their hosts while pursuing outdoor activities in plague endemic regions<sup>(13)</sup>. In Madagascar plague occurs more frequently in males than in females, although there is also a higher incidence among children<sup>(14)</sup>. As in nearly all endemic foci as well as the similar result in Tobruk, with plague is clearly a seasonal disease in Lushoto<sup>(15,16,17,18)</sup>, with a peak around the turn of the year<sup>(19)</sup>. The incidence of plague in Tobruk has increased in both rural and urban areas, because of multiple socioeconomic and environmental factors. In Tobruk the disease was mainly from June to August. In the United States, the plague season is from February Through August<sup>(20)</sup>. The highest infection was in Attarsha 29 cases in rural area, while the lowest infection in Haiy Azhoor 1 case in urban area. The total number of patients were diagnosed with bubonic plague (100%) in Tobruk. Similar result was reported in Lushoto (87.6%)<sup>(21)</sup>. Standard criteria for diagnosis of plague in Uganda are sudden onset of fever, chills, malaise, headache or prostration accompanied by either painful regional lymphadenopathy<sup>(22)</sup>. Patients likely acquired plague from rodent flea bites in Tobruk.

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