Outbreak of Louse-Borne Relapsing Fever among Urban Dwellers in Arsi Zone, Central Ethiopia, from July to November 2016

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Abstract. We report epidemiological and clinical aspects of an outbreak of louse-borne relapsing fever (LBRF) in Asella in Arsi Zone, central Ethiopia, from July to November 2016. A total of 63 LBRF cases were reported. The overall case fatality rate was 13% among treated patients. In this article, the first-line epidemiological assessment, individual prevention and control measures, and public health investigations and interventions in relation to this outbreak are described. Treatment recommendations for resource-limited settings are discussed by review of the latest literature.

INTRODUCTION

Louse-borne relapsing fever (LBRF) is a vector-borne disease that is typically characterized by the acute onset of febrile disease and several subsequent febrile relapses in untreated patients. It is caused by the spirochete *Borrelia recurrentis*, a human-restricted pathogen, which is transmitted from person to person by the human body louse *Pediculus humanus* under poor hygienic conditions. After an incubation period of approximately 2–15 days, LBRF is characterized by recurring episodes of high fever, headache, myalgia, nausea, and vomiting, with each episode lasting several days.^{1,2} Mortality is reported to be up to 40% in untreated patients and 2–5% in treated patients.² A common potential fatal complication of LBRF is the Jarisch–Herxheimer reaction (JHR). This febrile inflammatory reaction occurs in approximately 18–80% of patients in the first hours after treatment was initiated and is significantly associated with mortality.^{3,4} Therefore, clinical monitoring for the first 24 hours after the first dose of antibiotic treatment is generally recommended.⁵

Ethiopia is the only country where LBRF is still endemic with an estimated 10,000 LBRF cases annually.⁶ Occasionally, LBRF is found in the neighboring countries, such as Eritrea, Sudan, and Somalia.^{7–9} The biggest and only previous outbreak in Asella was recorded in 1991 after the Ethiopian civil war when 389 people were infected with a hospital fatality rate of 3.6%.¹⁰ During the rainy season, when multiple layers of blankets are worn to protect against the cold temperatures with increasing lice transmission as a consequence, LBRF cases occur sporadically.¹¹

SETTING

Even in comparison with other low-income countries in sub-Saharan Africa, the Ethiopian health system faces significant constraints.¹² The physician per population ratio is 1:48,000 and only half of the Ethiopian population has access to health-care services with often limited diagnostic and therapeutic facilities.¹² The Asella Teaching Hospital (ATH) is the medical referral center for a population of 3.2 million inhabitants in Arsi Zone of Ethiopia. The Asella Health Center (AHC) covers some of the most densely populated *kebeles* (smallest administrative unit) in Asella town.

CASE INVESTIGATION

In July 2016, a 17-year-old homeless male presented to the emergency ward of the ATH with 7 days of fever, headache, myalgia, and arthralgia and 2 days of vomiting. When Giemsa-stained blood film for the exclusion of malaria was performed, spirochetes were seen in high density and the diagnosis of LBRF was made (Figure 1). After the diagnosis of lice infestation, the young man was isolated and deloused. Subsequently, similar cases with severe febrile disease presented to the ATH or were reported from adjacent health centers, mostly affecting young men of low socioeconomic status, for example, day laborers. Between July and November 2016, a total of 63 cases of LBRF were reported in two health facilities in Asella (ATH and AHC).

A standardized questionnaire was developed and translated into the local language to collect information about patients' medical history and socioeconomic factors. In addition, interviews were conducted by staff of the Hirsch Institute of Tropical Medicine (HITM) and the Asella Health Bureau for the identification of potential sources of infection. Information was complemented for 54 patients retrospectively with data from medical records. Statistical analysis was performed with the IBM SPSS Statistics 22 software package (IBM Corp., Armonk, NY). Ethical approval was obtained from the ethical committee of the Arsi University (Reference Number #AU/HSC/120/6943/08).

Analyzing the epidemiological data, a private shelter used as a guesthouse was identified as the potential source of infestation with infected lice among day laborers (Figure 2). The shelter was shut down by the local public health authorities immediately after identification and prevention measures (burning blankets and mattresses) were taken to prevent further spreading of the disease.

In addition, public health awareness campaigns were arranged to inform health service centers and populations at risk (e.g., homeless and day laborers) about symptoms, diagnostic process, and preventive measures. Free screening for LBRF was offered at the local health facilities and the HITM.

TREATMENT AND PREVENTIVE MEASURES

Immediately after establishing the diagnosis, treatment was initiated and preventive measures were carried out, including shaving and washing clothes in hot water (minimum 60°C). Treatment regimens administered are shown in Table 1.

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The treatment most often used (42.6% of patients) was a combination of three antibiotics: doxycycline (100 mg or 200 mg p.o. twice daily for 7 days) and procaine penicillin (200,000 IU or 400,000 IU i.m. stat) plus ceftriaxone (1 g or 2 g i.v. once daily for 7 days) to treat potential concomitant infections, such as typhoid fever, the second most common febrile illness in Ethiopia (10%) after malaria (51.5%).¹³ Supportive treatment included diclofenac and fluid replacement with normal saline. Because of a high risk of JHR, all patients were admitted for a 24-hour-monitoring. After discharge from the clinic, the follow-up of LBRF cases was challenging and information about the further clinical outcome is not available for nine patients.

RESULTS

During a 5-month period, a total of 63 patients with confirmed LBRF were documented in the ATH and the AHC, (Figure 3). Sociodemographic and clinical characteristics were completed for 54 patients and used for the analysis, as shown in Table 1. Most patients were male (92.6%) and the median age was 22 years (interquartile range: 17–27 years). More than half of the patients were day laborers (57.4%) from the same geographically restricted area of Asella (*kebele* 4 and 6) in proximity of the market and bus station. Most common symptoms were fever (92.6%), headache (83.8%), and chills (77.8%), as shown in Table 2. Other symptoms included myalgia (48.2%), nausea/vomiting (27.8%), epistaxis (13.0%), rash (3.7%), and jaundice (1.9%). The case fatality rate among the analyzed LBRF cases was 13%. A JHR was reported in 7.4% of patients after treatment was initiated, of which one patient died.

DISCUSSION

This outbreak demonstrated that mainly young men with poor socioeconomic status, for example, day laborers and homeless, in Ethiopian highlands were at increased risk for infection with *B. recurrentis*. Lice infestation is often linked to low socioeconomic status, overcrowding, and poor personal hygiene.² Hence, source tracing is challenging in this population but necessary to identify further infected contacts to prevent further spreading of the disease among vulnerable populations.

FIGURE 1. Spirochetes in blood film, Giemsa staining.

Moreover, lack of awareness and poverty among this population prevented or delayed presentation to a health-care facility. Most of the patients could not afford the costs for diagnosis and treatment (approximately 7 US\$) and most fatal cases were recorded among patients who were already in critical conditions at admission because of late presentation. The clinical management, the follow-up, and prevention measures were particularly difficult among homeless patients, which was a possible explanation for the high fatality rate during this outbreak (13%) in comparison with a case fatality rate of 2–4% in previous LBRF reports.^{4,8,14–17} However, in nine of 63 patients, the outcome remained unknown and the number of undetected cases was estimated to be significant because most LBRF cases affected a marginalized population. Likewise, source tracking and initiation of preventive public health measures were difficult because this marginalized population often lives in informal dwellings.

A JHR was only recorded in 7.4% of LBRF patients, which was low compared with previous reports.^{4,14–16} Nevertheless,

FIGURE 2. Private shelter that offered low-cost accommodation with overcrowded rooms and poor hygiene conditions was identified as the potential source of infestation with *B. recurrentis*-infected lice.

TABLE 1

Sociodemographic factors, treatment, and outcome of louse-borne relapsing fever cases during the outbreak in Arsi Zone from July to November 2016

Population (N = 54)		No. of cases	Percent (%)
Median age: 22 years (IQR: 17–27 years)			
Gender	Male	50	92.6
Health facility	Asella Teaching Hospital	33	61.2
	Asella Health Center	21	38.8
Occupation	Day laborer	31	57.4
	Student	7	13.0
	Other	5	9.3
	Unknown	11	20.4
Treatment	Penicillin + doxycycline + ceftriaxone	23	42.6
	Penicillin + doxycycline	20	37.0
	Penicillin only	7	13.0
	Penicillin + ceftriaxone	3	5.5
	Unknown	1	1.9
Outcome	Discharged	46	85.1
	Died	7	13.0
	Referred to Addis Ababa	1	1.9

it has to be noted that no clear criteria were implemented to define the occurrence of JHR. Hence, the incidence of JHR might have been underestimated.

The choice of antibiotic treatment remained difficult to evaluate, as no international consensus has been made. In Ethiopia, tetracyclines, penicillin, ceftriaxone, erythromycin, or chloramphenicol were available as effective substances.¹⁸ In a meta-analysis of six randomized controlled trials on antibiotic treatment of LBRF, therapy with tetracyclines was shown to be significantly superior to penicillin for fever clearance and relapse rates.¹⁸ However, the incidence of JHR was significantly less among patients who were treated with penicillin.¹⁸ Hence, a single dose of procaine penicillin combined with tetracyclines for the following days was recommended^{18,19} and was shown to be safe and effective by minimizing the complications that are reported when each drug is used alone. The treatment at the AHC, under the direction of a single health officer, was standardized and in line with the Ethiopian guidelines using a combination of penicillin and tetracyclines,^{5,18} whereas the treatment in the ATH varied in accordance with the physicians', mainly young interns, evaluation. Potential coinfection with *Salmonella typhi* was normally treated with

TABLE 2

Symptoms reported among louse-borne relapsing fever cases in Asella, 2016

Symptoms (N = 54)	No. of cases	Percent (%)
Fever	50	92.6
Headache	45	83.3
Chills	42	77.8
Myalgia	26	48.2
Vomiting/nausea	15	27.8
Epistaxis	7	13.0
Rash	2	3.7
Jaundice	1	1.9

ceftriaxone considering antibiotic resistance against fluoroquinolones.²⁰ All fatalities were reported from the ATH. However, this observation could be explained by selection bias because severe cases were more likely to be transferred to the ATH.

In the setting of a resource-limited health system in Ethiopia, it is still difficult to control LBRF outbreaks at an early stage. Despite a recently initiated community-based health insurance for the informal sector,²¹ the Ethiopian health system is still not capable of covering treatment costs for some of the weakest populations. Hence, by excluding homeless and day laborers, who are at the highest risk for LBRF and other louse-borne infections,^{6,22} the general population is also put at risk.

Despite a recent increase of international interest in LBRF after multiple cases were imported into central Europe by refugees from East Africa,^{1,23} scientific data about LBRF are still scarce. Further research should be conducted to provide evidence for diagnosis and treatment on individual- and population level. Moreover, a stronger support of national public health systems is needed to establish adequate response mechanisms for future outbreaks, including marginalized populations.

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FIGURE 3. Number of louse-borne relapsing fever (LBRF) cases per week in Asella from July to November 2016.

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