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Rift Valley Fever in Southwestern Saudi Arabia: A sero-epidemiological study seven years after the outbreak of 2000–2001

Tarik A. Al-Azraqi[a], Awad A. El Mekki[b], Ahmed A. Mahfouz[c,*]

[a] Department of Internal Medicine, College of Medicine, King Khalid University, Abha, Saudi Arabia
[b] Department of Clinical Microbiology, College of Medicine, King Khalid University, Abha, Saudi Arabia
[c] Department of Family and Community Medicine, College of Medicine, King Khalid University, Abha, Saudi Arabia

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ABSTRACT

The objective of the present study was to measure seroepidemiology of Rift Valley Fever virus infection in the Southwestern regions of Saudi Arabia and to determine the potential risk factors leading to Rift Valley Fever virus infection. Through a series of field trips to the study area (Jizan, Aseer and Al-Qunfuda), a random sample of the general population (patients and their relatives) attending the outpatients' clinics for any reasons were included. Through questionnaire interviews, data were collected regarding their sociodemographic status, housing conditions, animal contact and other relevant information. Blood samples were taken and tested for RVF-specific IgG and IgM utilizing commercially available enzyme-linked immunosorbent assays (ELISAs). Out of 2322 persons included in the study, only 139 were positive for RVF-specific IgG thus giving an overall prevalence of 6.0%. On the other hand, none of the study samples were found to be sero-positive to RVF-specific IgM. The study revealed zero prevalence of specific IgM and IgG among pre-school children born after the 2000–2001 outbreaks. Using multivariate binary logistic regression analysis to identify potential risk factors associated with sero-positive RVF IgG, the following significant risk factors were identified: lack of electricity, having animals in the house, history of slaughtering animals, contact with or transporting aborted animals. The study documented the lack of recent RVF activity among humans in the study areas since the outbreak of 2000 and therefore, the rigorous control measures undertaken together with fostering public health messages in the region should be maintained to reduce the risk of animal-to-human transmission as a result of unsafe animal husbandry and slaughtering practices.

1. Introduction

Rift Valley Fever virus (RVF) a phlebovirus of the Bunyaviridae family (enveloped, segmented RNA viruses) was first isolated in Kenya in 1930 (Daubney et al., 1931). Large epizootics, mainly affecting ruminants, are known to occur in Kenya, South Africa, Namibia, Mozambique, Zimbabwe, Zambia, Somalia, Sudan and Egypt (Woods et al., 2002; Jouan et al., 1988; Kiazek et al., 1989; Swaneepoel, 1981; El-Akkad, 1978). Zinga, a bunyavirus, characterized by one of us (El-Mekki et al., 1981) is a RVF strain circulating in Senegal where epizootics of the disease are also known to occur (Zeller et al., 1997). RVF has also been isolated in many other equatorial African countries. Huge economical loses consequently afflict these countries due to death and abortions of infected livestock (Woods et al., 2002). About ten years ago, and for the first time in its history, RFV crossed its geographical boarders to Asia: outbreaks have been simultaneously reported in the southern region of Saudi Arabia and northern Yemen (CDC, 2000).

Human infections are acquired through handing of infected animals. Infected hematophagus mosquitoes (aedines, culicines and anophelines) also transmit the disease, with the latter two species serving as epidemic vectors (Swanepoel, 2000). In southwest Saudi Arabia, RVF was isolated from Aedes vexans arabiensis (Miller et al., 2002). Mechanical transmission by blood-sucking flies (midges, phlebotomids, stomoxids and simulids) is known to occur (Swanepoel, 2000).

Like many other arbovirus infections, the majority of human RVF infections are subclinical. Many clinically apparent cases, following a short incubation period of 2–6 days, are associated with sudden onset of fever, rigors, headache, retro-orbital pain, photophobia, muscle and joint pains, vertigo, epistaxis and a petechial rash. In a well-documented cross sectional study, following the outbreak of RVF in Southern Saudi Arabia, Al-Hazmi et al. (2000, 2003) reported a higher frequency of various ocular complications among laboratory confirmed RVF cases than previously reported. Swanepoel (2000) reported that the overall mortality rate is about 1%.

* Corresponding author at: Department of Family and Community Medicine, College of Medicine, King Khalid University, Abha, P.O. Box 641, Saudi Arabia.
E-mail address: mahfouz2005@gmail.com (A.A. Mahfouz).

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Enzyme immunoassays detecting specific IgM and IgG are currently employed to document a recent RVF infection and a past exposure, respectively (Meegan et al., 1987). Despite their inherent limitations, enzyme immunoassays have been extensively used in seroepidemiological surveys and laboratory diagnosis of RVF infection in animals and humans: Abu Elyazeed et al., 1996, have utilized RVF-specific IgM immunoassays for screening of the occupationally exposed abattoir workers in the Nile delta following the 1993 outbreak. More recently, during the Rift Valley Fever outbreak in East Africa (1997–1998), the WHO Task Force for Hemorrhagic Fever used well-calibrated enzyme-immunoassays for the detection of virus-specific IgM and IgG among exposed humans (WHO, 1990). Enzyme immunoassays have also been used in the detection of these antibodies among various animal species during RVF outbreaks in Mauritania (Nabeth et al., 1992). Recently, in a large sero epidemiological study of RVF in animals in Saudi Arabia, Mohamed et al. (2011) utilized isotope-specific ELISA to document past exposure of sheep and goat to RVF.

About ten years ago, and for the first time in its history, Rift Valley Fever virus infection (RFV) crossed its geographical boarders to reach Asia. By the first of November 2000, 516 cases of severe RVF infection had been admitted to health-care centers and hospitals in the southern region, of whom 87 (17%) died (Al-Hazmi et al., 2003). By the end of the outbreak (22 September 2001), the total number of hospitalized cases amounted to 884 of whom 843 were laboratory confirmed (Madani et al., 2003). Although RVF persisted in the Epizootic areas in Saudi Arabia and few intermittent cases have been observed among animals (Al-Afaleq and Hussein, 2011), no RVF outbreaks or human cases have been reported in the Kingdom of Saudi Arabia since the last outbreak.

Seroepidemiological studies are valuable tools in the determination of the state of immunity among the general population to a particular infectious agent such as RVF in the affected zone. The objectives of this work were to measure seroepidemiology of Rift Valley Fever virus infection in Southwestern regions of Saudi Arabia and to determine potential risk factors leading to Rift Valley Fever virus infection.

2. Methods

2.1. The study area

The study area (Figs. 1 and 2) included Jizan, Aseer regions and Al Qunfuda area in the Makkah region. Jizan area is located in the southwest of Saudi Arabia, bordering the northwestern region of Yemen. The region is inhabited by 1,186,139 people (Saudi Ministry of Health, 2006). The climate is hot and humid most of the year. The majority of inhabitants work as farmers and raise domestic animals for a livelihood. Electric power is not yet available for the vast majority of the remote villages. Air-conditioning and the use of electric fans are therefore not possible in those areas. As a result, villagers frequently sleep outdoors to avoid the high indoor temperatures and, thus, are intensely exposed to mosquito and other hematophagus arthropod bites.

The Aseer region is located in the southwest of Saudi Arabia covering an area of more than 80,000 km^2. The region extends from the high mountains of Sarawat (with an altitude of 3200 m above sea level) to the Red Sea, and lies few kilometers from the northern border of neighboring Yemen. The Aseer region is bordering Jizan and is located to its northeast. The population of Aseer is 1,688,368.

Al-Qunfuda is a further northward extension of this coastal plain in the Makkah region. The population of Al-Qunfuda is 240,938 people. The social and environmental conditions in these 3 study areas are similar. Health care facilities in the study areas include 13 hospitals and 134 primary health care centers (PHCCs) in Jizan, 17 hospitals and 253 PHCCs in Aseer, and one hospital and 29 PHCCs in Al-Qunfuda (Saudi Ministry of Health, 2006).

2.2. Sample size determination

Using WHO manual for Sample Size Determination in Health Studies (Lwanga and Lemeshow, 1990) with a conservative anticipated population proportion of 5% (LaBeaud et al., 2008), and with an absolute precision of 1% at 95% confidence interval, the minimal sample size required for the study was calculated to be 1825 cases.

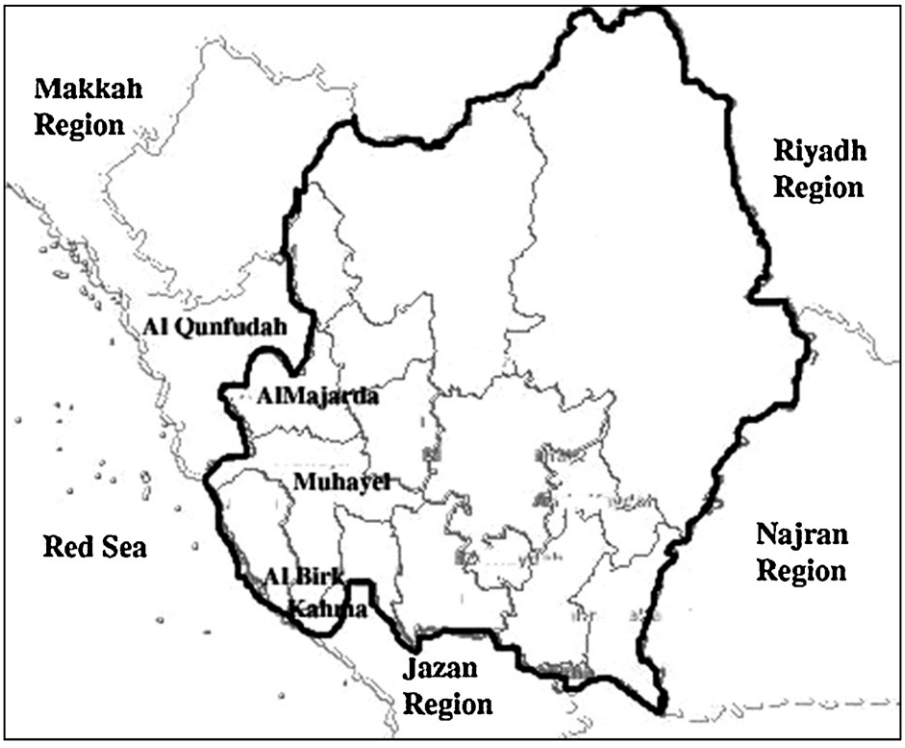

Fig. 1. Map of Southwestern Saudi Arabia showing the study areas of Asir region and Al Qunfudah.