Report

Surveillance for dengue fever in Jeddah

Hassan I. Ghaznawi,[1] Taha O. Al-Khateeb,[2] Naeema Akbar,[3] Huda Afifi [3] and Nasser Alhamdan [4]

Introduction

Dengue fever is an acute self-limited illness characterized by diphasic fever, headache, arthralgia, myalgia, rash, lymphadenopathy and leucopenia [*1*]. Dengue haemorrhagic fever is a severe form of classic dengue, manifested by thrombocytopenia and haemoconcentration. In severe cases, circulatory failure and shock (dengue shock syndrome) result from immune enhancement due to reinfection with a different serotype [*2*]. Dengue fever is caused by the mosquito-borne dengue virus. The primary vector is *Aedes aegypti*; *A. albopictus* is a second potential vector [*3*]. Dengue virus is an enveloped RNA virus classified in the flavivirus genus (formerly called group B arbovirus) of the Togaviridae family [*4,5*].

Despite the occurrence of dengue fever in some other countries bordering the Red Sea during the last ten years, such as Sudan, Senegal, Djibouti and Yemen, its appearance in Jeddah, Saudi Arabia was not expected as the geographical characteristics of Jeddah City (e.g. low rainfall of <60 mm/year) are not suitable for the natural breeding of the vector.

A Saudi male was diagnosed as a case of dengue haemorrhagic fever at the hospital for tropical diseases in London on 12 October 1993; he had contracted the disease while in Jeddah. Two cases of dengue haemorrhagic fever and dengue shock syndrome were diagnosed and later confirmed indicating the recent introduction of the virus to Jeddah. Surveillance was initiated in Jeddah on 6 March 1994 by the Disease Control Division (DCD) of the Ministry of Health. Physicians in government and private sectors were alerted to careful handling of cases of fever with any of the following symptoms: acute frontal headache, retro-orbital pain, joint and muscle pain, skin rash 48 hours after the onset of fever or signs of bleeding. Once suspected, a complete blood cell count and measurement of haematocrit is to be done. If the complete blood count reveals low white blood cell and platelet counts, the case is immediately reported to DCD, where a case investigation is carried out. A blood specimen is also sent to the laboratory for serological testing and virus isolation. A second blood specimen is collected two weeks later. A confirmed case is any case with one of the following: a) virus isolation, b) IgM positive or c) seroconversion.

[1]*Associate Professor of Community Medicine, King Abdul Aziz University, Jeddah, Saudi Arabia.*
[2]*Director, King Saud Hospital and Director, Disease Control Division, Jeddah, Saudi Arabia.*
[3]*Epidemiologist, King Saud Hospital, Jeddah, Saudi Arabia.*
[4]*Director, Field Epidemiology Training Programme, Jeddah, Saudi Arabia.*
Received: 18/8/96, accepted: 29/7/97

The total number of cases up to 26 August 1995 was 1064, of which 665 were confirmed cases. The male/female distribution was 70.7%/29.3%. The distribution by nationality was as follows: Saudis (47.3%), Egyptians (12.2%), Yemenis (10.2%), Pakistanis (6.3%), Sudanese (4.7%), Bengalis (3.2%), Indians (2.9%), Philippinos (2.6%), others (10.6%).

A number of factors, such as low rainfall (<60 mm/year) and a good municipal water system have made the customary sites like gardens, flower boxes, etc. impractical for breeding. However, the tremendous expansion of the city and addition of new residential districts has led to a great increase in the number of fresh water containers being used at these sites, and these have proved to be potential breeding sites for mosquitos. In addition, the surveillance process showed that a high proportion (37%) of the reported cases were construction workers, 32% were family residents and 31% were single male residents.

Methodology

A case–control study was conducted to assess the possibility that construction activity is related to infection with the dengue virus. It included only cases among resident families. For each case, controls were chosen from the same reporting hospital or clinic. The control/case ratio by clinic ranged from 2:1 to 5:1, depending on disease density in the district of the reporting clinic.

The surveillance questionnaire included demographic data and data on residence, type and site of work, history of exposure to mosquito bites, detailed clinical symptoms and signs of dengue fever, laboratory results and treatment measures. It also included information about the possible breeding sites, and location and building stage of construction sites in relation to both residence and workplace. Proximity to labourers' camps, the presence of fresh-water tanks, swimming pools or fountains and the frequency of visits to such areas were also included in the questionnaire.

Districts were divided into two groups according to the density of the disease (stratum 1 = low density, stratum 2 = high density). Variables were classified into two groups, personal and mosquito breeding sites. We assessed independence of association between potentially interrelated construction activities and dengue fever using an unconditional regression model on *Egret*. We also assessed the spacial relation and stage of construction.

Results

Demographic analysis

Age distribution showed a higher proportion of older people in the controls. Females accounted for 48% of cases and 42% of controls, while Saudis accounted for 86% and 81% respectively. The ratio of controls to cases was higher among preschool children, housewives and retired people. There were statistically significant differences between residence in buildings of traditional style versus those of modern design.

Risk factors for breeding sites

Univariate analysis. In the high-disease-density districts (stratum 2), the results showed a high association between the incidence of disease and the presence of construction work [odds ratio (OR) = 7.8, 95% confidence interval (CI) = 1.58–52.36]. Stratified analysis showed higher OR for the presence of a construction site next to the house (OR = 9.8, 95% CI = 1.8–69.1) or

across the street (OR = 8.7, 95% CI = 1.4–67.5), but a lower OR if the site was one or two buildings away. None of the risk factors resulted in any significant OR in the low-disease-density districts (stratum 1).

Multivariate analysis. The OR was statistically significant for construction sites (OR = 7.8, 95% CI = 1.58–52.36), sites where cement construction blocks are made (OR = 18.3, 95% CI = 1.95–43.1), construction labourers' camps (OR = 8.6, 95% CI = 1.18–46.4) and water tanks (OR = 8.8, 95% CI = 2.2–38.7). The presence of standing water in swimming pools, fountains and gardens, or natural water collection all resulted in an OR of approximately 1.0.

Discussion

The definition for dengue cases was highly specific as confirmation was restricted to viral isolation and increased IgM antibodies. The presence of uncovered tanks or barrels at construction sites provides female mosquitos access to places to lay their dessication-resistant eggs. Hosts for the virus are labourers who spend the day at construction sites and rest in shady places where the *A. aegypti* mosquito prefers to bite. Labourers move from site to site and so the virus, which moves primarily with the viraemic host, can be transmitted a greater distance than the mosquito's short flight range of 100 m.

At the districts with high disease density, high ORs were obtained for the presence of sites where cement construction blocks are made, labourers' camps and water tanks. All these variables are characterized by the presence of both the host and the breeding sites for the vector.

At the districts with low disease density, the disease was present in those residents with the disease because of their frequent visits to the districts with high disease density. Clustering of the disease among friends, relatives and neighbours, who usually live nearby or visit each other, suggests that the disease is restricted to limited transmission foci in Jeddah City.

Management of the disease depends upon early diagnosis, case investigation and health education on the importance of interrupting the chain of transmission of the disease. Cooperation of those with the disease and their contacts was sought to control the adult and larval forms of the mosquito in and around the residential areas. This involved a combined effort between the Ministry of Health and the Jeddah Municipality.

Recommendations

- Control of *A. aegypti* and *A. albopictus* at construction sites and labourers' camps is essential.
- An entomological survey should be conducted to study the resting and resistance habits of adult *A. aegypti* and *A. albopictus* at these sites.
- Long-term suppression of the adult mosquito population should be ensured through larval control measures concentrating on water tanks used at construction sites, such as covering tanks and encouraging the installation of a piped water supply at such places.
- Control measures should be monitored by applying mosquito traps at dengue fever foci.
- The surveillance programme in the city should be continued and case reporting from other regions requested.
- Further case–control investigations on construction workers and people in related jobs should be conducted.

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