An outbreak of dengue fever at a tertiary care centre, Haryana, India: a triggered catastrophe in 2006

Paramjeet Singh Gill1*, Antariksh Deep1, Uma Chaudhary1, Meenu Gill2 and Harpreet Singh3

Received 19 September, 2007 Accepted 12 August, 2008 Published online 6 October, 2008

Abstract: Cases of dengue fever have been on the rise in the northern part of India over the last decade. Rohtak district of Haryana State in northern India experienced its first large scale outbreak of dengue fever in the year 2006. Out of four serotypes causing dengue fever in the present outbreak, DEN-3 was the predominant serotype. Out of 701 suspected cases of dengue fever, 152 cases (21.7%) tested positive for IgM anti-dengue antibodies and 104 cases (14.8%) for both IgM and IgG anti-dengue antibodies. Fifty per cent of the cases were in the age-group of 11-30 years. We analyzed various contributory factors for the occurrence of the present outbreak. We also identified an important triggering factor, i.e. the inordinate delay in the completion of a rainwater drainage project by civic authorities leading to the collection of rainwater in artificial containers that acted as ideal breeding sites for Aedes mosquito. The present outbreak should serve as an eye-opener for health care authorities as well as the civic administration hoping to prevent future outbreaks in developing countries.

Keywords: dengue fever, DHF, DSS, contributory factors, triggering factors, DEN-3, multiple serotypes

INTRODUCTION

Dengue, a mosquito-borne disease and the most common arboviral illness transmitted globally, is caused by infection with one of the four serotypes (DEN-1, DEN-2, DEN-3 and DEN-4) of dengue virus and has been classified as a major global threat by the World Health Organization. An estimated 2.5 – 3.0 billion people in approximately 100 countries are at risk for dengue infection, and each year approximately 50 million people are infected, out of which 500,000 cases of dengue hemorrhagic fever (DHF) require hospitalization, with a mortality of 2.5% [1].

The emergence of dengue fever (DF)/DHF/dengue shock syndrome (DSS), as a major public health problem, has been most dramatic on the Indian subcontinent. This is mainly due to expanding geographic distribution of both the virus and the vectors resulting from the urbanization process, recent increases in the frequency of epidemics, development of hyperendemicity (co-circulation of multiple virus serotypes) and the emergence of DHF in new areas [2-10].

Since the first isolation of dengue virus in 1945 [11], Delhi, the capital city of India, has experienced outbreaks of dengue fever (DF) in the years 1967, 1970, 1982 and 1988 [12-15].

The first extensive epidemic of DF/DHF/DSS occurred during 1996 in northern India. Delhi and its neighboring areas were severely affected and accounted for a total of 8,900 cases with a death rate of 4.2% [16, 17]. The causative agent was confirmed to be exclusively DEN-2 by cultivation and immunofluorescence with type-specific monoclonal antibodies. The 1996 outbreak marked the resurgence of dengue virus infection in India.

The next increase in DF/DHF/DSS cases was noted in 2003 with 2,135 cases. Concurrent infection with multiple serotypes of dengue virus has been reported from various other countries since the 1980s, but infection with all four serotypes was reported for the first time from northern India in the year 2003. The predominant causative agent was found to be DEN-3 [9, 18, 19].

In the year 2006, a major dengue fever epidemic broke out in Delhi [10]. The important feature of the 2006 outbreak was the recurrence of concurrent infection with all four serotypes, DEN-3 again being the predominant serotype. The other important feature of the 2006 outbreak was
its severity as well as the extent of the spread of infection engulfing most of the adjoining parts of the neighboring state of Haryana, especially Rohtak.

A district of Haryana situated about 70 kilometers northwest of Delhi, Rohtak has rarely been attacked by dengue virus, even during the previous Delhi outbreaks. Only a few isolated DF cases have been reported so far from the rural areas in Rohtak.

For the first time, however, we report a major outbreak of DF from a tertiary care centre, Postgraduate Institute of Medical Sciences (PGIMS), Rohtak, Haryana. Apart from the occurrence of concurrent infection with multiple serotypes, we analyzed important geographical, demographic, environmental and entomological factors and searched for a triggering factor for the present outbreak. We also tried to establish a correlation among the factors which led to the sudden upsurge of dengue fever cases in the year 2006.

MATERIAL AND METHODS

A total of 701 patients were reported at PGIMS as suspected cases of dengue fever from September to December 2006.

Five-milliliter blood samples were collected from all the suspected cases of dengue fever, i.e. patients with febrile illness of 3 ‑ 7 days duration and two or more associated features like headache, retro-orbital pain, arthralgia, myalgia, rash, hemorrhagic manifestations and leucopenia.

Serum was separated and tested for the presence of IgM and IgG anti-dengue antibodies using dengue IgM capture ELISA (MAC-ELISA, Pan Bio, Australia) and dengue duo IgM and IgG rapid strip test (Pan Bio, Australia).

RESULTS

Fever was present in all cases, with an average duration of 4.5 +/- 2 days and headache (522, 74.5%), backache (498, 71%), pain in wrist joints (338, 48.2%), and retro-orbital pain (231, 32.9%) as the other presenting complaints. The youngest case was 6 years old and the oldest 62 years old, and the male to female ratio was 1.4:1. Laboratory investigations revealed thrombocytopenia (a platelet count of < 100,000/µl) in about 31.5% of cases and leucopenia (WBC <3,000/mm³) in 28.2% cases.

In the present outbreak, 94% of suspected cases of dengue fever presented in the months of October and November. More than 50% of cases were positive for either IgG or IgM or both parameters of dengue serology. Fifty per cent of the total suspected cases of DF were in the age group of 11-30 years, an observation consistent with that of other studies on dengue fever in India [19, 20]. A total of 56 (36.8%) of 152 patients positive for IgM anti-dengue antibodies and 43 (41.4%) of 104 patients positive for both IgM and IgG anti-dengue antibodies were in the age-group of 21-30 years (Table 1).

DISCUSSION

The laboratory criteria for confirmation of dengue fever include isolation of dengue virus from serum and detection of dengue virus genomic sequence by nucleic acid amplification techniques. The limiting factor is the availability of such tests in only a few reference laboratories. However, positivity with one or more serological test, like a) specific IgM antibody detection in single serum sample, b) seroconversion of IgM, and c) four-fold difference in titre of IgG antibody, in serum samples of suspected patients was considered to be a confirmatory criterion [21].

Data on dengue fever collected over the past three years (2003 ‑ 2005) at PGIMS, Rohtak was analyzed and compared with the 2006 year data, revealing a substantial increase in the number of dengue fever cases in the year 2006.

Table 1: Distribution of suspected cases of dengue with respect to age-group and serological profile for the year 2006.

<table>
<thead>
<tr>
<th>Anti-Dengue antibodies</th>
<th>&lt;10 (14.5%)</th>
<th>11-20 (25.7%)</th>
<th>21-30 (36.8%)</th>
<th>31-40 (11.8%)</th>
<th>&gt;40 (11.2%)</th>
<th>TOTAL (21.7%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IgM</td>
<td>22</td>
<td>39</td>
<td>56</td>
<td>18</td>
<td>17</td>
<td>152</td>
</tr>
<tr>
<td>IgG</td>
<td>08</td>
<td>11</td>
<td>34</td>
<td>24</td>
<td>35</td>
<td>112</td>
</tr>
<tr>
<td>Both</td>
<td>04</td>
<td>15</td>
<td>43</td>
<td>23</td>
<td>19</td>
<td>104</td>
</tr>
<tr>
<td>None</td>
<td>41</td>
<td>70</td>
<td>84</td>
<td>61</td>
<td>77</td>
<td>333</td>
</tr>
<tr>
<td>TOTAL</td>
<td>75</td>
<td>135</td>
<td>217</td>
<td>126</td>
<td>148</td>
<td>701</td>
</tr>
</tbody>
</table>
Out of a total of 701 suspected cases, 368 (52.5%) were serologically positive cases. One hundred and fifty two cases (41%) were positive for IgM antibodies, with 95 cases (62%) being in the age group of 11-30 years.

A monthly comparison, especially in the post-monsoon months in the year 2006, of suspected dengue cases with respect to IgM profile with the *Aedes* larva density (Breatheu index, calculated by the District Entomology Department, Rohtak) revealed a concurrent substantial rise in the number of cases of dengue with the increase in *Aedes* larva density in Rohtak (Figure 2). This dramatic rise in *Aedes* larva density during the post-monsoon months has not been observed in previous years.

Geographic and Demographic factors: Rohtak is only 70 kilometers from Delhi and has a considerable number of people who commute to Delhi daily for their livelihood, a practice that has been common for the past 10-15 years. In the past 3-4 years, however, the number of daily commuters has increased substantially due to better earning opportunities in Delhi. This could be an important factor in the spread of the first dengue infections in Rohtak from Delhi in September 2006.

Environmental factors: Another contributory factor is the huge power cuts and irregular water supply to the residents of Rohtak in the past few years. Due to such inconvenience, people have started storing water for drinking purposes in earthenware pots (Figure 3A). Secondly, because of the lack of awareness regarding infections due to stagnant water, the water in air coolers is not drained off when not in use. Such practices have made water collection sites highly suitable for *Aedes* mosquito breeding.

Entomological factor and the triggering point: Another factor which could have played a major role in the occurrence of the present outbreak is the project to install an extensive network of rainwater drainage pipes as a renovation drive in Rohtak. This project started in March 2006 and was scheduled to finish by July 2006, i.e. before monsoon season. Unfortunately, due to the lack of proper management by the civic administration, the project extended far beyond monsoons and carried on until February 2007. This delay in the project completion resulted in inefficient water drainage with almost all the main roads of the city being dug and left open during the monsoon season (Figure 3B). This led to the collection of monsoon water in small discarded containers, tyres, earthenware fragments, etc. outside the residential areas. That in turn provided ideal breeding sites for the *Aedes* mosquito, culminating in a dramatic rise in *Aedes* larva density in the post-monsoon months of 2006 (as per the entomological surveillance conducted by the District Entomology Department, Rohtak).
CONCLUSION

The present upsurge of dengue cases in Rohtak is a result of multiple contributory factors, triggered by the improper management of a rainwater drainage development project (Figure 4).

The 2006 Rohtak outbreak of dengue fever exposes the paucity or non-functioning of various vector control programs. Secondly, it points to the lack of dengue fever awareness among state health care authorities and the resulting panic among the people of this city. As a result, a large number (47.5%) of non-dengue fever cases were presented at the hospital, causing a huge burden on the hospital care services (Tables 1).

The pathogenesis of DHF is still unclear [22, 23], although since the 1970s secondary infection with a different serotype has been suspected to be a risk factor for DHF [24, 25]. In view of the occurrence of dengue fever outbreaks with multiple serotypes in developing regions like Rohtak, if this antibody-dependent enhancement (ADE) hypothesis is verified, the next outbreak may lead to DHF/DSS with a high mortality and morbidity.

Thus, in order to prevent the recurrence of dengue fever and the occurrence of DHF/DSS (as per the ADE hypothesis) in the Rohtak district, its neighboring areas, and also other regions around the globe which have experienced their first dengue outbreaks, the present outbreak of dengue fever should sound a warning bell about the need for strict implementation of various vector control programs.

A year-round surveillance program should include fever surveillance through sentinel sites in public/private hospitals or at the level of primary health care centers with strengthening of referral at community health centers (CHC)/district hospitals, epidemic preparedness and response, entomological surveillance (larval surveys), vector control programs (anti-larval measures, source reduction, personal protection and fogging during outbreaks), enactment and enforcement of legislation (building and civic byelaws to contain mosquitogenic conditions), inter-sectoral convergence, and monitoring and supervision. These are some of the important programs which need to be followed to ensure that the scare of dengue outbreak can be confined to a few isolated areas.

Figure 4: Schematic diagram of the role of various contributory factors simultaneously acting together in the occurrence of the dengue outbreak in Rohtak, 2006.
ACKNOWLEDGEMENT

We thank Mr Ramphal and Mr Sanjay, technicians in the virology laboratory in the Department of Microbiology, PGIMS, Rohtak for their diligent work and technical assistance throughout the dengue outbreak. Thanks are also due to Dr. (Ms.) Indra, Sr. entomologist, District Entomology Department, Rohtak for providing entomological data required for the compilation of results. Last but not least, we would like to thank the distributors, M/S Haryana Scientific Emporium, Rohtak for timely and continuous supply of the dengue diagnostic kits during the months of the dengue outbreak. Thanks are also due to Mr Ramphal and Mr Sanjay, technicians in the virology laboratory in the Department of Microbiology, PGIMS, Rohtak for their diligent work and technical assistance throughout the dengue outbreak.

REFERENCES