Original Research Article

A study on the outbreak of dengue fever in a tertiary care children's hospital in southern Tamil Nadu, India

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ABSTRACT

Background: Dengue fever is the most rapidly spreading mosquito-borne viral disease in the world. Incidence has increased 230-fold with increasing geographic expansion with potential for further spread. The rapidly expanding global footprint of dengue is a public health challenge with an economic burden. This study's objective is to assess the outbreak of epidemic of dengue fever in a tertiary care children hospital and to describe their socio-demographic, clinical outcome and serological profile.
Methods: It is an observational descriptive study conducted for a period of 1 year in less than 12 years old children in a tertiary care hospital at Southern Tamil Nadu.
Results: Among the 360 children admitted with dengue fever, there were 198 boys (55%) and 162 (45%) were girls. Maximum incidence of dengue incidence was seen in infants less than 1 year (25%). The highest number of cases were admitted during September and October. The most common affected age group was less than 3 years with 179 (49%). Among the cases, 297 (82%) were of severe dengue which constitute dengue haemorrhagic fever-183(38%) and Dengue shock syndrome 114 (62%). Serological analysis showed NS1 Ag was positive in 144 children (40%), Dengue IgM was positive in 54 children (15%), both IgM and IgG positive in 126 children (35%) and IgG was positive in 36 children (10%). Out of the total children admitted with dengue fever, the case fatality was 0.5% (2 children).
Conclusions: This study highlights the importance of WHO clinical criteria for early diagnosis of severe dengue. Moreover, the early and intensive management reduces the mortality significantly.

Keywords: Dengue fever, Dengue haemorrhagic fever, Dengue shock syndrome, Mechanical ventilation

INTRODUCTION

Dengue fever is the most rapidly spreading mosquito-borne viral disease in the world. An estimated 50 million infections per year occur across approximately 100 countries. Incidence has increased 230-fold with increasing geographic expansion with potential for further spread.[1] The rapidly expanding global footprint of dengue is a public health challenge with an economic burden that is currently unmet by licensed vaccines, specific therapeutic agents, or efficient vector control strategies. Cyclic epidemics are increasing in frequency and geographic expansion globally and also in India.

The primary vector *Aedes aegypti* mosquito, has become widely distributed across tropical and subtropical latitudes. Dengue fever is a self-limited though debilitating illness characterized by fever, headache,

gastrointestinal disturbances, body pains and rash. More severe dengue is marked by increased vascular permeability, thrombocytopenia, and haemorrhagic manifestations; in severe cases fluid leakage into the interstitial spaces results in shock, which without appropriate treatment may lead to death. Children and young adults are the populations that are most affected[1]. A second infection with a different serotype leads to more severe form of the disease than the primary infection.[2] Studies have shown that the infecting serotype determines the severity of the illness with DEN 2 and DEN 3 causing the most severe form of the disease.[3]

Dengue fever has a wide spectrum of presentation. It can range from a subclinical infection to full blown shock. The latest guidelines from WHO has used simplified categories for diagnosis and management: dengue fever is classified into three categories (1) dengue without warning signs; (2) dengue with warning signs; (3) severe dengue (severe haemorrhage, plasma leak, organ impairment).[4]

One of the most common laboratory finding in dengue is thrombocytopenia. Bleeding in dengue can vary from minor petechial haemorrhage to severe haemorrhage causing death of the patient. Mean platelet volume (MPV) can be used as an independent predictor of bleeding. A low MPV indicates marrow suppression and increased risk of bleeding. In India DEN 1 and DEN 2 are the most common serotypes isolated. The infecting severity determines the severity of the disease. DEN 2 causing the most severe form of the infection and increased mortality.

The main objective of the study was to assess the outbreak of an epidemic of Dengue fever in a tertiary care children hospital and to describe their socio-demographic, clinical outcome and serological profile.

METHODS

The present study was an observational descriptive study conducted in Gerde Gutperle Agasthiarmuni Child Care Center-a tertiary care children referral hospital at Vellamadam in Thovalai Panchayat, at Kanyakumari district in Tamilnadu. The study period was from October 2014 to September 2015. The study population included laboratory confirmed cases of children with dengue fever with age less than 12 years. Sociodemographic factors such as age, gender, residential address, family income and others were noted.

Clinical history was collected in detail. A thorough clinical examination including blood pressure, capillary refilling time, tourniquet test was performed. The diagnosis of dengue fever was based on WHO guidelines 2009 as severe dengue fever which included Dengue Haemorrhagic Fever (DHF) and dengue shock syndrome (DSS) and nonsevere Dengue (with or without warning sign).[4]

Routine laboratory tests were done according to clinical management, and the results were recorded. An extra sample was collected from the patient at the time of admission for dengue serotype assessment. Other co-morbid conditions and complications were noted. Treatment details, including fluid management, intake output and any platelet or packed red cell transfusions received by the patient were noted.

Inclusion criteria

- Children under 12 years with high fever, headache, retro orbital pain, leg pain, abdominal pain, decreased urine output, features of shock, bleeding manifestations, suggestive of Dengue fever were included.
- NS1 Ag for Dengue positivity.
- Dengue Ig-M/ Ig G positivity.

Exclusion criteria

- Children with NS1 Ag and dengue IgM and IgG negativity.
- Children with chronic diseases.

RESULTS

A total of 360 children were enrolled in the study. Among them 198 (55%) were males. The male female ratio was 1.22:1. The most common affected age was less than 3 years with 179 children (49%). In the analysis of the locality of affected children, Panagudi and Vallioor were the places with peak incidence from where 132 children (37%) got admitted. Kalakad and Radhapuram recorded the lowest incidence with 45 children (12%). The epidemiological and demographic parameters are given in Table 1.

Table 1: Epidemiological and demographic parameters of children admitted with dengue fever.

Parameters	Sub parameters	Number	Percentage
Age	<3 years	174	49%
	4-6 years	69	19%
	7-9 years	69	19%
	10-12 years	48	13%
Sex	Males	198	55%
	Females	162	45%
Locality	Panagudi &Valliyoor	132	37%
	Vellamadam and nearby	84	23%
	Kalakkad& Radhapuram	45	12%
	Kanyakumari Dist	99	28%

The highest numbers of cases were admitted during September and October which include 128 (35.5%) cases. The lowest number of cases were present in April and May months.

All the 360 children were diagnosed clinically as per the WHO guidelines 2009 as severe dengue (DHF and DSS) and non-severe dengue (with or without warning signs) [4]. Almost all the clinical criteria as per the WHO were met with, in all the 360 children. Out of the 360 children with clinically suspected dengue infection, severe dengue was seen in 297 (82%) constituting dengue shock syndrome in 114(38%) children and DHF in 183(62%) children.

There were 63 children with non-severe DF (18%). Among the children admitted with dengue fever, 13 children tested positive for malarial parasite. They were all from seashore area (Muttom, Collachel and Pallam). Out of 114 children with DSS, 2 children had acute fulminant hepatic failure, 11 children had dengue encephalopathy, and 1 child had pulmonary haemorrhage/DIC/ARDS. All the patients were managed as per the WHO treatment protocol for DF/DHF/DSS.[4]

Among the children admitted with clinical diagnosis of dengue fever, serology was done. NS1 Ag was positive in 144 children (40%), dengue IgM was positive in 54 children (15%), both IgM and IgG were positive in 126 children (35%) and dengue IgG was positive in 36 children (10%). During the intensive management of children with severe dengue, 19 (5.2%) children needed mechanical ventilatory support and 95 children did not require the same.

Table 2: Clinical outcome and serological profile of children with dengue.

Parameter	Sub parameter	Number	Percentage
Dengue according to severity	DF	63	18%
	Severe dengue (DHF +DSS)	297	82%
	DHF	183	50%
	DSS	114	32%
Dengue Serology	IGM +ve	54	15%
	NS 1 Ag +ve	144	40%
	Both IGG & IGM +ve	126	35%
	IGG +ve	36	10%
Children required who Mechanical ventilation		19	5.2%
Children who needed blood products		38	10.5%
Case Fatality		2	0.5%

Out of 114 children treated with DSS, 38 (10.5%) children needed blood transfusion-in the form of fresh whole blood, Packed red cells, Fresh frozen plasma, Platelet rich concentrate according to their lab parameters, clinical situations, and bleeding manifestations. The clinical and serological profile of children is given in Table 2.

Regarding the treatment outcome of 360 children admitted with dengue fever, 2 children died (0.5% case fatality ratio). One child died of DSS with acute fulminant hepatic failure evidenced by highly elevated liver enzymes. Another child died of refractory shock, who was referred from outside in moribund condition. The one who had pulmonary haemorrhage, disseminated intra vascular coagulation and ARDS survived miraculously.

DISCUSSION

There were 360 patients who fulfilled WHO criteria of DF/DHF/DSS. In the present study, incidence of dengue fever was found more in males. The male female ratio was 1.22:1. Similar finding was seen in majority of dengue studies. In the study done by Sharma NL et al the ratio was 1.2:1.[5] This may be due to factors like traditional full body covering in females compared to males and males are more exposed to mosquito bites as they play more often in open fields.

The maximum incidence of infection was seen in below 3 years (49%), and minimum incidence in children between 10 to12 years of age (13%). In many other studies, the older children were more affected. In the study done by Selvan et al the most common age group was 10-12 years.[6] In the North Indian dengue outbreak in 2006 also similar pattern was seen.[7] The contrasting finding seen in our study may be due to fact that majority of our study population were living in areas with unplanned construction dwellings and water stagnation problems leading to fertile breeding ground for mosquitoes. As the children below 3 years spend most of the time inside home, they got more prone for mosquito bites. This shows the importance of effective source reduction awareness programs for the public. Moreover, this highlights the endemic nature of dengue viral infection with children acquiring infection at an early age.

In our study, dengue infection was most frequent during the month of September and October. Kanyakumari district had the maximum rainfall during the month of September in the year 2013. A cyclical pattern of increased transmission coinciding with monsoon and post monsoon as it is the breeding season for Aedes mosquitos. Similar finding was also seen in the studies done by Ahmad S et al and Sharma NL et al.[8,5]

Out of the 360 patients, 32 cases (37%) were from Vallioor and Panagudi which are urban areas. It is worth to note that only 84 cases (23%) from the rural areas which include Vellamadamand Thovalai. The pattern of epidemic outbreak of dengue feverwas almost identical to children in South East Asian region. DHF is an endemic disease in many large cities of Thailand, eventually spreading to smaller towns and villages during the period

of epidemic transmission.[2] Usual pattern is that of small outbreak in urban areas that steadily increase in size until there is an explosive outbreak that bring the disease to the attention of public health authorities.

Among the children with clinically suspected Dengue infection, Severe Dengue was seen in 297 (82%) constituting Dengue Shock Syndrome in 114(38%) children and DHF in 183(62%) children. Similar finding was seen in the study done by Mittal et al in 2012 in which 91% of patients had severe dengue.[9] In another study by Kumar et al, the severe dengue proportion was 50%.[10] In another study by Jain et al in 2017, the severe dengue proportion was 48.3%.[11] This major proportion of severe dengue category children in our study can be explained by the fact that our institution is a charitable institution and get more references of very poor sick patients from nearby hospitals.

In the children admitted with clinically dengue infection, dengue serology was done for all cases. The sample for NS1 Ag for dengue fever was taken for first or second day of illness and dengue serology was taken during the acute phase of illness. The present study showed primary infection in 54 cases (15%) indicated by the presence of IgM antibodies in the serum and secondary infection in 36 cases (10%) indicated by the presence of IgG antibodies in the serum. Similarly, in the study done by Changal et al in 2016, 11.7% patients had secondary dengue infection.[12] But in the study done by Vikram et al, the secondary infection rate was 25.3%.[13] Regarding other serological parameters, only NS1 Ag in 144(40%) cases. But in the study done by Sharma NL et al, 9% of cases were positive for NS1 antigen only.[5]

Persons, who were never previously infected with a flavivirus, mount a primary antibody response when infected with Dengue virus. The dominant immune-globulin isotype is IgM. Anti-dengue IgM detectable by IgM antibody-capture enzyme linked immunosorbent assay (MAC-ELISA) appears in half of the patients with a primary infection while they are still febrile; in the other half, it appears within 2-3 days of defervescence. In one series of dengue patients (infection confirmed by virus isolation or paired serology) 80% had detectable levels of IgM antibody by day 5 of illness and of 99% by day 10. Once detectable, IgM levels rise quickly and appear to peak about 2 weeks after the onset of symptoms. They then decline to undetectable levels over 2 to 3 months. Anti-dengue IgG appear shortly afterwards. In secondary Flavi virus infections, which accounts for most cases of DHF, the dominant immunoglobulin isotope is IgG. The levels of IgM are detectably lower. In contrast to primary infection, secondary infection with dengue virus results in the appearance of high levels ant dengue IgG before, or simultaneously with the IgM response. Once detected IgG levels rise quickly, peak about 2 weeks after the onset of symptoms and then decline slowly over 3-6 months.

The mortality rate was 0.5% (2 cases) in our study. Both the children who died had DSS with one child having acute fulminant hepatic necrosis and the other child died of refractory shock. In the study done by Sharma G et al in Rajasthan also the case fatality was 0.5%.[14] In another study done by Krishnamoorthy et al the case fatality ratio was 1.8%.[15] In WHO manual, it was highlighted that, if untreated the fatality was 30 to 40% in patients with DSS.[16] It is worthwhile to note that the survival of dengue infected children is directly related to early and intensive management.

CONCLUSION

This study highlights the WHO clinical criteria for early diagnosis of dengue fever and its severity. The need for early detection and diagnosis of severe dengue fever as per the WHO guidelines is essentially very important. This should be augmented with early and intensive management which reduces the mortality significantly.

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