DENGUE

Jayanandana Karunasinghe
National Science Foundation

Introduction

The word dengue (pronounced 'Dhen gey') is an African word and the word defines "breakbones" since the time when Benjamin Rush from Philadelphia first described it as 'breakbone fever' in 1780. There is no breaking of bones in a patient suffering from Dengue but the meaning indicates the severe pain that is being felt to the body. Dengue fever is a mosquito borne viral infection common throughout the tropical and subtropical regions of the world, predominantly in urban and peri-urban areas. It has now become a major international public health concern. It is a flu-like illness ranging from symptom free (non-specific viral syndrome) to classical fever with hemorrhagic manifestations. It affects infants, young children and adults but rarely causes death.

History of dengue in the World and Asia

Dengue virus was first isolated in 1943, is morphologically undistinguishable from the agent causing yellow fever. Dengue hemorrhagic fever (DHF) a potentially lethal complication was first recognized during the 1950s and today it is a leading cause of childhood mortality in several Asian countries. Its hemorrhagic nature as a new symptom was identified in 1953 in Philippines, after 3 years of this discovery; it was able to increase the death toll in Manila by 6%. The first reported epidemics of dengue fever occurred in 1779-1780 in Asia, Africa and North America, the near simultaneous occurrence of outbreaks on three continents indicates that these viruses and their mosquito vector have had a worldwide distribution in the tropics for more than 200 years.

During most of this time dengue fever was considered benign and nonfatal disease of visitors to the tropics. A global pandemic dengue began in Southeast Asia after World War11 and has intensified during the last 15 years. In South-east Asia epidemic DHF first appeared in the 1950s, but by 1975 it had become a leading cause of hospitalization and death among children in many countries in that region. Afterwards the disease appeared as outbreaks occasionally in South-East Asia. In the 1980s DHF began a second expansion into Asia when Sri Lanka, India and Maldive Islands had their first major DHF epidemics.

The global prevalence of dengue has grown dramatically in recent decades. The disease is now endemic in more than 100 countries in Africa, America, Eastern Mediterranian, South-East Asia and Western Pacific. According to WHO, 2500 million people (2/5) of the world population are now at risk from dengue. Current estimates show that there may be 50 million cases of dengue infection worldwide every year. Not only the number of cases increasing but the disease is also spreading to new areas. For example, in Brazil 475000 suspected cases were reported between January and October 1998.

Prevalence of the disease in Sri Lanka

It has been reported that clinical dengue like disease prevailed in the beginning of 19th century but it was serologically confirmed as dengue in 1962. It occurred as a plague in 1967. In the same year 08 people died from the disease and 28 were seriously ill. After that a less number of patients recorded in the country and in 1970 no suspected dengue patients were reported except a few occasional cases. But during the period 1987- 98, it was observed that the disease had been spread fast. From 1969 to 1988 it was witnessed that a circulation of multiple dengue serotypes with dengue fever in urban areas.

According to the Figure 1, before 1989 there had been reported only 8 patients from Sri Lanka. But in 1989,dengue suspected cases had been increased up to 203 out of which 20 were reported to be dead. In 1990, the number of suspected DF/DHF patients had been increased up to 1350 and 54 of them died. During the first 6 months of 2000, the situation worsened.

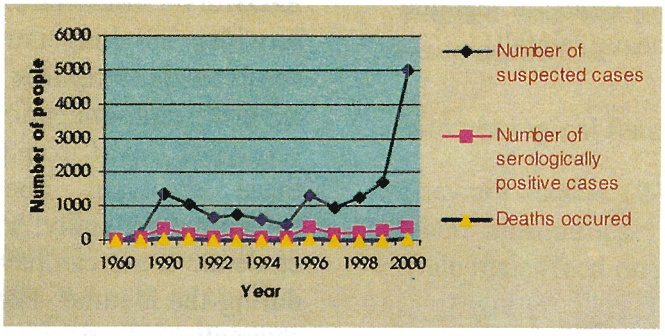

Fig. 1: Reported cases of DHF in Sri Lanka

It can be seen that during the period from 1991 to 1995 the number of suspected cases have been increased from 440 to 1048, out of which 54 died. In 1996, 1294 patients were reported and there were 54 deaths. Therefore dengue has reached the epidemic stage during the last 4 years in Sri Lanka. In 1996 and 1999, 1294 and 1699 cases were reported with an average case fatality rate of 1.8%.

According to Dr T.A. Kulathilake of Epidemiological Unit of Colombo General Hospital, there was a marked increase in the disease to the level of a plague in 2000 with about 5000 patients suspected of having dengue had been admitted to various hospitals around the country for treatments. Out of 5000, 400 were confirmed as Dengue patients and 30 had died from the diseases. In comparison, in 1999, 1699 patients were hospitalised and 300 were confirmed as having dengue and 14 died from the disease. These indicate how dengue has attained epidemic level during the year 2000 in Sri Lanka and how it has caused much effect on the normal life in Sri Lanka.

Prominent areas where Dengue outbreaks occurred

When we look into the areas where patients were reported, in 1990 the cases reported from Colombo and sub-urban areas are high compared with the number of cases reported from out-stations. The respective Colombo suburban areas were Nugegoda, Maharagama, Dehiwala, Mount-Lavinia, Kotte, Piliyandala, Ragama, Negombo, Kalutara, Beruwala, Moratuwa, Galle and Tangalle. Patients were reported from Anuradhapura too.

In 2000, Dengue cases were first reported from Matara area. The first death was also reported from Matara. However the patients were reported from other areas such as Colombo, Gampaha, Kegalle, Galle and Kurunegala where dengue is being reported frequently. In 1999 too, 1981 cases suspected of having dengue had also been reported from Colombo area.

The living agent responsible for Dengue

The dengue fever and dengue hemorrhagic fever are caused by a Flavi (Genus: *Flavivirus*, Family: Flaviridea) virus, which belongs to Arbo virus group. Arbo is defined as "Arthopodborne" (Arthropod origin). This virus has four flavors called serotypes, which are creatively named DEN-1, DEN-2, DEN-3, DEN- 4. They are closely related but antigenically distinct, RNA flavivirus. Symptoms may vary according to the serotypes. A serotype refers to how many antigens in different viruses have in common. In these types there can be virus types with minor changes. Epidemiologists believe that recently the dengue has spread in Sri Lanka as a plague causing a panic situation due to the infection by virulent type of viruses. It was observed that the suspected cases of dengue have been increased after a heavy rainfall.

Fig 2 : Electro micrograph of Flavi virus (Source : Internet)

Difference of dengue from the traditional contagious diseases like measles and chicken pox

DHF is more likely to be developed in a person who had previously infected from Dengue than in a person who had not been infected from dengue. The reason for this situation could be that there are four distinct but closely related viruses (serotypes), which cause dengue. When one was ill from one serotype of virus at the first time, he or she could be ill at the second time by another serotype of the virus. But this situation is somewhat different from measles and chicken pox where it is very rare for a person to be infected from the virus of measles and chicken pox if the person had been suffered from the same at an earlier stage.

Recovery from infection by one serotype provides life long immunity against only that serotype but confers only partial protection against subsequent infections by other serotypes. Apart from that infection with one of these serotypes does not provide cross-protective immunity, so people living in dengue epidemic areas can have four dengue infections during the lifetime. There is good evidence that sequential infection increases the risk of more serious disease resulting in DHF. This is the fact that a person can have dengue for the second time although he or she had been contacted dengue earlier.

It has also been noticed that, dengue hemorrhagic fever (DHF) causes the condition critical for persons who are having the disease for the second time than for persons who have it for the first time. DHF is more likely to be developed if an individual previously infected with one serotype is later infected with a different viral strain. It has been observed that the antibodies formed in the body during first infection may cause some serious situation in

the second time. The antibodies that are produced from one serotype (virus type) in the body will act to facilitate the incoming and growth of a new virus type in the body rather than reacting against incoming of the new virus types into the body. Then the person will get the illness easily at the second time. This opinion is believed at present since 90% of cases that had the disease had been suffered from dengue more than once. Since these ideas are not yet proved, research must be performed to determine exactly what synergistic properties these serotypes exhibit.

Transmission:

The dengue viruses are transmitted to humans through the bites of infective female mosquitoes. Mosquitoes generally obtain the virus while feeding on the blood of an infected person. Once infected, a mosquito is capable of transmitting the virus to susceptible individuals for the rest of the life during probing and blood feeding.

Infected female mosquitoes may also transmit the virus to the next generation of mosquitoes by transovarial transmission e.g. via eggs. But humans are the main host of the virus. In some regions of the world like Africa, monkeys may become infected and perhaps serve as a vector for uninfected mosquitoes. The virus circulates in the blood of infected humans for 2-7 days, at the same time they have fever, mosquitoes may get the virus when they feed on a person at this time.

Vector

The mosquitoes responsible for transmission of the flavi virus are of two species, which belongs to the genus *Aedes*. They are called *Aedes aegpti* and *Aedes albopictus*. These mosquitoes have been identified as living in clean water in vessels. Common mosquito breeding sites are

- discarded canned fish tin, clay pots
- used empty milk pots and bottles
- discarded automobile tyres
- coconut shell and discarded king-coconut
- water storage plastic vessels and polythene bags
- indoor and out door flower pots
- insect traps kept for table legs
- puddles of water left by rains

The main reason for the rapid growth of mosquito population is that even under some minor wet conditions the eggs of these mosquitoes could survive (when the rain stopped and the puddles evaporated) without being destroyed.

Morphological features of Mosquitoes

They are smaller (2-4 mm in size) compared to other mosquitoes. Only females suck blood while males feed on nectar.

Identification:

Aegypti	Albopictus
Distinctly visible black and white rings on the legs Silver markings on the surface of thorax	Horizontal single white line on the surface of the thorax

Normally they are active and bite people during daytime. It has been reported that they are very active during 6 to 9 in the morning and 3 to 5 in the evening of the day.

Eggs : Float as a collection, like a raft in water
Larvae: Swim at an angle to the water surface
Adults : Rest parallel to the surface

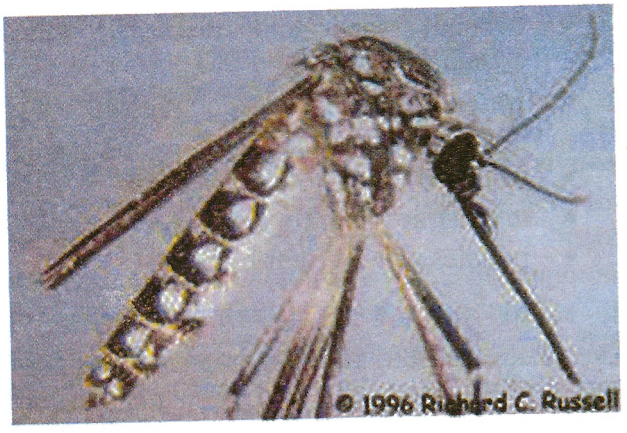

Fig 3: Vector mosquito (Genus : Aedes)

Symptoms

Symptoms of dengue appear within 5-8 days after entry of the virus into the body of an individual. Sometimes it can take 3 to 15 days. This is called the incubation period. Symptoms do not appear just after infection by the virus. The immune system of the body fight back with the virus and only if the body fails to overcome the virus, the symptoms would appear.

***Basic clinical features*:**

Dengue virus infections cause a spectrum of illnesses ranging from symptom free, mild fever to classical dengue fever (DF) and dengue fever with hemorrhagic conditions (DHF) and dengue shock syndrome (DSS).

a) *Classical dengue fever*:

Dengue fever is a severe, flu-like illness that affects children and adults but rarely causes death. Mild and nonspecific in most children associated with pharngitis, rhinitis and mild fever for 2-5 days. The basic symptoms of classical dengue fever most likely to occur in older children and adults can be mentioned as follows,

- fever
- severe headache
- pain behind the eyes
- muscle and joint pains ("breakbone" pain)
- back pain and skin rash, mild cough

At this stage it is advisable to rest and take drugs like Parasitamol to abate fever. If there is a doubt about dengue, patients should be prevented in taking drugs like Aspirin that will react in opposite of gathering blood platelets causing internal bleeding of the body.

b) *Dengue hemorrhagic fever*:

This stage is a potentially deadly complication characterized by the following features:

- High fever- continues for 2-7 days, can be as high as 40-41^{0}C
- Severe headache
- Hemorrhagic phenomina often with the enlargement of the liver, in severe cases circulatory failure, facial flush, spontaneous bleeding from eyes, nose, ears, mouth, skin and gums, bleeding with stools and urine, vomiting of blood

The reason for this hemorrhagic condition is the changes in blood clotting mechanisms. In addition fluid plasma in blood may secrete out from blood vessels. This internal bleeding could lead to the shock syndrome.

Fever can be abated by giving more fluids. Normally the fever is abated within 3-5 days and patient is also cured within several days.

c) *Dengue Shock Syndrome (DSS)*

The patient's condition may suddenly deteriorate after a few days of fever and the temperature drops and the patient may go rapidly into a critical state of fatal shock. The following features could be seen during the period,

- shock development
- drop in body temperature, sweating
- circulatory failure causing changes in blood pressure
- drop in platelet count and packed cell volume
- continuous internal bleeding (leakage phase)
- the body turns pale

WHO classification of dengue fever

Grade 1	Fever, constitutional symptoms
Grade 11	Grade1 + spontaneous bleeding (skin, gums, GI tract)
Grade 111*	Grade 11 + circulatory failure and agitation
Grade IV*	Grade 111+ profound shock, unrecordable blood pressure

* dengue shock syndrome

Treatment:

There is no specific treatment for dengue fever. Treatment is supportive. However careful clinical management will save the lives of DHF patients. Plenty of fluids are given to patients and it is important to take rest as much as possible. Currently no dengue vaccine exists.

Vaccine development is difficult because any of four different viruses may cause disease and protection against only one or two viruses could actually increase the risk of more serious disease. Research is underway in the development of vaccines and vaccines may not be immediately forthcoming since the cause of the disease itself requires more studies.

Prevention and Control:

- The only method of controlling and preventing the disease is to combat the breeding of vector mosquitoes
- Prevent from mosquito bites using mosquito nets, coils and fumes and wearing clothes
- Curing the patients from hospital treatments
- Identification of patients from blood tests, platelet counts etc.
- Launch programmes to create awareness about the disease especially at school level

References

1. Prof Tissa Vitarana, Story of dengue coming with various dangers, *SAPATHA*, 1990(1-4), 1-5 pp

2. Hana Ibrahim, Dengue the scourge of the new millennium, Observer, published on 2000-11-20, 6-8 pp

http://www.cdc.gov.ncidod/dvbid/dengue/index.htm (CDC dengue fever home page)