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RESEARCH ARTICLE

EPIDEMIC OF DENGUE IN DEVELOPING COUNTRIES LIKE INDIA AND ITS CONTROL.

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Abstract

Dengue fever (DF) is known as one of the most important arthropod-borne viral diseases affecting humans. Over the past several decades, major outbreaks of DF have occurred in many countries including India, causing significant morbidity and mortality. The magnitude of the DF issue remains alarming.The virus has been spreading its geographic reach partly due to increased urbanization and partly due to climate change. With increasing dengue threat, comes an accelerated effort to combat and control the virus. In addition to studies on preventing the transmission of the virus, progress on vaccine development has been made. Because there is currently no effective vaccine against dengue and no specific treatment for the disease, controlling and preventing dengue fever outbreaks are essential steps for keeping people healthy. The World Health Organisation (WHO) classifies dengue as a disease important in public health. The epidemiology and ecology of dengue infections are strongly associated with human habits and activities. Preventing or reducing dengue virus transmission depends entirely in controlling the mosquito vectors or interruption of human–vector contact. WHO promotes the strategic approach known as Integrated Vector Management (IVM) to control mosquito vectors, including those of dengue.

Introduction:-

Dengue epidemics are known to have occurred over the last three centuries in tropical, subtropical and temperate areas of the world. These epidemics were clinical dengue fever, although some were associated with the severe haemorrhagic form of the disease. Efforts to control Aedesaegypti and economic development have markedly reduced the threat of epidemic dengue in temperate countries during the past 50 years[1,2,3]. The first confirmed epidemic of DHF was recorded in the Philippines in 1953-1954. Since then, major outbreaks of DHF with significant mortality have occurred in most countries of the South-East Asia Region, including India, Indonesia, Maldives, Myanmar, Sri Lanka, and Thailand, as well as in Singapore, Cambodia, China, Laos, Malaysia, New Caledonia, Palau, Philippines, Tahiti and Vietnam in the Western Pacific Region[4]. Over the past 20 years, there has been a dramatic increase in the incidence and geographical distribution of DHF, and epidemics now occur each year in some South-East Asian countries.

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Dengue is caused by a virus spread by Aedes (Stegomyia) mosquitoes. Over the past two decades there has been a dramatic global increase in the frequency of dengue fever (DF) dengue haemorrhagic fever (DHF), and dengue shock syndrome (DSS) and their epidemics, with a concomitant increase in disease incidence. The World Health Report1 1996 stated, that the "re-emergence of infectious diseases is a warning that progress achieved so far towards global security in health and prosperity may be wasted." The report further indicated that "infectious diseases range from those occurring in tropical areas (such as malaria and DHF which are most common in developing countries) to diseases found worldwide (such as hepatitis and sexually transmitted diseases, including HIV/AIDS) and food-borne illnesses that affect large numbers of people in both the richer and poorer nations.

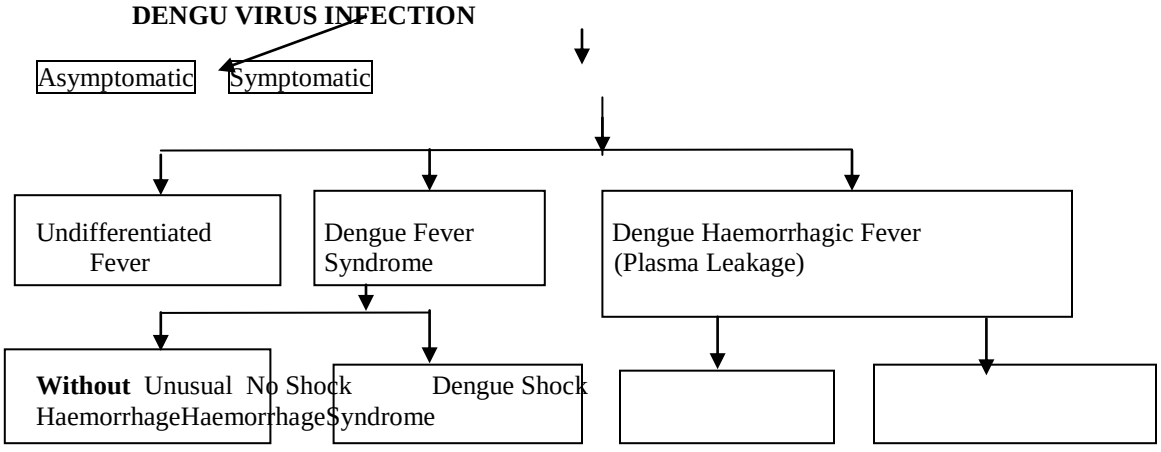
The dengue viruses are members of the genus Flavivirus and family flaviviridae. These small (50 nm.) viruses contain single-strand RNA. The virion consists of a nucleocapsid with cubic symmetry enclosed in a lipoprotein envelope. The dengue virus genome is approximately 11,000 base pairs in length, and is composed of three structural protein genes encoding the nucleocaprid or core protein (C), a membrane-associated protein (M), an envelope protein (E), and seven nonstructural protein (NS) genes. The envelope glycoprotein is associated with viral haemagglutination and neutralization activity. . There are four virus serotypes which are designated as DEN-1, DEN-2, DEN-3 and DEN-4. Infection with any one serotype confers lifelong immunity to that virus serotype. Although all four serotypes are antigenically similar, they are different enough to elicit cross-protection for only a few months after infection by any one of them.

Dengue viruses are transmitted from person to person by Aedes (Ae.) mosquitoes of the subgenus Stegomyia. Ae.aegypti is the most important epidemic vector, but other species such as Ae. albopictus, Ae. polynesiensis, members of Ae. scutellaris complex, and Ae. (Finlaya) niveus have also been incriminated as secondary vectors. Dengue viruses infect humans and several species of lower primates. Humans are the main urban reservoir of the viruses. The female Aedes (Stegomyia) mosquito usually becomes infected with dengue virus when she takes blood from a person during the acute febrile (viraemic) phase of illness. After an extrinsic incubation period of 8 to 10 days, the salivary glands of the mosquito become infected and the virus is transmitted when the infective mosquito bites and injects the salivary fluid into the wound of another person. Following an incubation period in humans of 3-14 days (4-6 days average), there is often a sudden onset of the disease, with fever, headache, myalgias, loss of appetite, and a variety of nonspecific signs and symptoms, including nausea, vomiting and rash.

Viraemia is usually present at the time of or just before the onset of symptoms and lasts an average of five days after the onset of illness. This is the crucial period when the patient is most infective for the vector mosquito and contributes to maintaining the transmission cycle if the patient is not protected against vector mosquito bites.

Clinical spectrum of dengue infection:-

Dengue virus infections can cause a spectrum of illness ranging from the asymptomatic mild undifferentiated fever, to classical dengue fever (DF), dengue fever with haemorrhagic manifestations, and dengue haemorrhagic fever (DHF)



Clinical Diagnosis of Dengue Infection:-

1. High continuous fever of 3 days or more
2. Abdominal pain
3. Petechial haemorrhage and/or other spontaneous bleeding
4. Rash – generalised flushing/maculopapular
5. Hepatomegaly
6. Fall in platelet count that precedes or occurs simultaneously with a rise in haematocrit
7. Normal WBC or leucopaenia with relative lymphocytosis
8. Normal ESR (< 20mm per hour)
9. Shock

Atypical presentations

1. Acute abdominal pains, diarrhoea, severe gastrointestinal haemorrhage[5,6]
2. Severe headache, convulsions, altered sensorium [7]
3. Encephalitic signs associated with or without intracranial haemorrhage[7]
4. **Irregular pulse and heart rate [6,7]**
5. Respiratory distress [8]
6. Fulminant hepatic failure, obstructive jaundice, raised liver enzymes [9], Reye syndrome
7. Acute renal failure, haemolyticuraemic syndrome [6]
8. Disseminated intravascular coagulation (DIC)

Management of a child with suspected dengue infection:-

Criteria for admission (any of the following) in the presence of suspicion of dengue fever:

1. ***Restlessness or lethargy***
2. ***Cold extremities or circumoral cyanosis***
3. Bleeding in any form
4. Oliguria or reluctance to drink fluids
5. Rapid and weak pulse
6. Capillary refill time > 2 seconds
7. Narrowing of pulse pressure (< 20mmHg) or hypotension
8. ***Haematocrit of 40, or rising haematocrit***
9. Platelet count of less than 100,000/mm^3
10. Acute abdominal pain
11. Evidence of plasma leakage, e.g. pleural effusion, ascites

If patient refuses admission, parent should be advised to:

1. ***Encourage child to drink fluids***
2. Observe for coldness / blueness of extremities
3. Administer Paracetamol for fever 10-15mg/kg/dose 4-6 hourly (limit to 5 doses in 24 hours)
4. Tepid sponging as necessary
5. Avoid aspirin and non-steroidal anti-inflammatory drugs

Parents must bring the child back immediately to the nearest hospital in the presence of any one of the following situations:

1. ***Not drinking / feeding poorly***
2. Passing less urine than usual
3. Abdominal pain
4. Bleeding in any form
5. In older children, inability to sit up, giddiness
6. ***Irritability, drowsiness, restlessness***
7. Child continues to be unwell

Prevention and Control Measures:-

No vaccine is available yet for the prevention of dengue infection and there are no specific drugs for its treatment. Hence DF/DHF control is primarily dependent on the control of Ae. aegypti.

Environmental Management:-
Environmental management involves any change that prevents or minimizes vector breeding and hence reduces human-vector contact[11-14]. The World Health Organization (1982) has defined three kinds of environmental management viz. Environmental modification, which involves long-lasting physical transformation of vector habitats, environmental manipulation, which includes temporary changes to vector habitats that involve the management of "essential" and "nonessential" containers; and management or removal of "natural" breeding sites and changes to human habitation or behaviour.

Environmental Modification:-
Improved water supply:-
Whenever piped water supply is inadequate and available only at restricted hours or at low pressure, the storage of water in varied types of containers is encouraged, thus leading to increased Aedes breeding. The majority of such containers are large and heavy (e.g storage jars) and can neither be easily disposed of nor cleaned. In rural areas, unpolluted, disused wells become breeding grounds for Ae. aegypti. It is essential that potable water supplies be delivered in sufficient quantity, quality and consistency to reduce the necessity and use of water storage containers that serve as the most productive larval habitats.

Mosquito-proofing of overhead tanks/cisterns or underground reservoirs:-
Where Ae.aegypti larval habitats include overhead tanks/cisterns and masonry chambers of piped waterlines, these structures should be mosquito-proofed. Mosquito-proofing of domestic wells and underground water storage tanks should be undertaken.

Flower pots/vases and ant traps:-
Flower pots, flower vases and ant traps are common sources of Ae. aegypti breeding. They should be punctured to produce a drain hole. Alternatively, live flowers can be placed in a mixture of sand and water. Flowers should be removed and discarded weekly and vases scrubbed and cleaned before reuse. Brass flower pots, which make poor larval habitats, can be used in cemeteries in place of traditional glass containers. Ant traps to protect food storage cabinets can be treated with common salt or oil.

Aedes breeding in incidental water collections:-
Desert (evaporation) water coolers, condensation collection pans under refrigerators, and air conditioners should be regularly inspected, drained and cleaned.

Building exteriors:-
The design of buildings is important to prevent Aedes breeding. Drainage pipes of rooftops sunshades/porticos often get blocked and become breeding sites for Aedes mosquitoes. There is a need for periodic inspection of buildings during the rainy season to locate potential breeding sites.

Solid waste Disposal:-
Solid wastes, namely tins, bottles, buckets or any other waste material scattered around houses, should be removed and buried in land fills. Scrap material in factories and warehouses should be stored appropriately until disposal. Household and garden utensils (buckets, bowls and watering devices) should be turned upside down to prevent the accumulation of rain water.

Glass bottles and cans:-
Glass bottles, cans and other small containers should be buried in land fills or crushed and recycled for industrial use.

Personal Protection:-
Protective clothing:-
Clothing reduces the risk of mosquito biting if the cloth is sufficiently thick or loosely fitting. Long sleeves and trousers with stockings may protect the arms and legs, the preferred sites for mosquito bites. Schoolchildren should adhere to these practices whenever possible.

Mats, coils and aerosols:-
Household insecticidal products, namely mosquito coils, pyrethrum space spray and aerosols have been used extensively for personal protection against mosquitoes. Electric vaporizer mats and liquid vaporizers are more recent additions which are marketed in practically all urban areas.

Repellents:-
Repellents are a common means of personal protection against mosquitoes and other biting insects. These are broadly classified into two categories, natural repellents and chemical repellents. Essential oils from plant extracts are the main natural repellent ingredients, i.e. citronella oil, lemongrass oil and neem oil. Chemical repellents such as DEET (N, N-Diethyl-m-Toluamide) can provide protection against Ae. albopictus, Ae. aegypti and anopheline species for several hours. Permethrin is an effective repellant when impregnated in cloth.

Insecticide-treated mosquito nets and curtains:-
Insecticide-treated mosquito nets (ITMN) have limited utility in dengue control programmes, since the vector species bites during the day. However, treated nets can be effectively utilized to protect infants and night workers who sleep by day. They can also be effective for people who generally have an afternoon sleep.

Biological ControL:-
The application of biological control agents which are directed against the larval stages of dengue vectors in South-East Asia has been somewhat restricted to small-scale field operations[15-17].

Fish:-
Larvivorus fish (Gambusiaaffinis and Poeciliareticulata) have been extensively used for the control of An. stephensi and/or Ae. aegypti in large water bodies or large water containers in many countries in South-East Asia. The applicability and efficiency of this control measure depend on the type of containers.

Bacteria:-
Two species of endotoxin-producing bacteria, Bacillus thuringiensis serotype H-14 (Bt.H-14) and Bacillus sphaericus (Bs) are effective mosquito control agents. They do not affect non-target species. Bt.H-14 has been found to be most effective against An. stephensi and Ae. aegypti, while Bs is the most effective against Culexquinquefasciatus which breeds in polluted waters.

Chemical Control:-
Chemicals have been used to control Ae. aegypti since the turn of the century. When the insecticidal properties of DDT were discovered in the 1940s, this compound became a principal method of Ae. aegypti eradication programmes in the Americas. When resistance to DDT emerged in the early 1960s, organophosphate insecticides, including fenthion, malathion and fenitrothion were used for Ae. aegypti adult control and temephos as a larvicide. Current methods for applying insecticides include larvicideapplication and space spraying.

Space sprays:-
Space spraying involves the application of small droplets of insecticide into the air in an attempt to kill adult mosquitoes. It has been the principal method of DF/DHF control used by most countries in the Region for 25 years. Unfortunately, it has not been effective, as illustrated by the dramatic increase in DHF incidence in these countries during the same period of time. Recent studies have demonstrated that the method has little effect on the mosquito population, and thus on dengue transmission.

Long Term Prevention Strategy:-
Community Participation:-
Community participation (CP) has been defined "as a process whereby individuals, families and communities are involved in the planning and conduct of local vector control activities so as to ensure that the programme meets the local needs and priorities of the people who live in the community, and promotes community's self-reliance in respect to development. Objectives of community participation in dengue prevention and control:-

1. To extend the coverage of the programme to the whole community by creating community awareness.
2. To make the programme more efficient and cost-effective, with greater coordination of resources, activities and efforts pooled by the community.

3. To make the programme more effective through joint community efforts to set goals, objectives and strategies for action.
4. To promote equity through sharing of responsibility, and through solidarity in serving those in greatest need and at greatest risk.
5. To promote self-reliance among community members and increase their sense of control over their own health and destiny.

Community level:-
People should not only be provided with knowledge and skills on vector control, but education materials should empower them with the knowledge that allows them to make positive health choices and gives them the ability to act individually and collectively.

Systems level:-
To enable people to mobilize local actions and societal forces beyond a single community, i.e. health, development and social services.

Political level:-
Mechanisms must be made available to allow people to articulate their health priorities to political authorities. This will facilitate placing vector control high on the priority agenda and effectively lobby for policies and actions.

Defining Community Actions:-
For sustaining DF/DHF prevention and control programmes, the following community actions are essential:
1. At the individual level, encourage each household to adopt routine health measures that will help in the control of DF and DHF, including source reduction and implementa-tion of proper personal protection measures.
2. At the community level, organize "clean-up" campaigns two or more times a year to control the larval habitats of the vectors in public and private areas of the community. Some key factors for the success of such campaigns include extensive publicity via mass media, posters and pamphlets, proper planning, pre-campaign evaluation of foci, execution in the community as promised, and follow-up evaluations. Participation by municipal sanitation services should be promoted.
3. Where community-wide participation is difficult to arrange for geographical, occupational or demographic reasons, participation can be arranged through voluntary associations and organizations. The people in these organizations may interact daily in work or institutional settings, or come together for special purposes, i.e. religious activities, civic clubs, women's groups and schools.
4. Emphasize school-based programmes targeting children and parents to eliminate vector breeding at home and at school.
5. Challenge and encourage the private sector to participate in the beautification and sanitary improvement of the community as sponsors, emphasizing source reduction of dengue vectors.
6. Combine community participation in DHF prevention and control with other priorities of community development. Where municipal services (such as refuse collection, wastewater disposal, provision of potable water, etc.) are either lacking or inadequate, the community and their partners can be mobilized to improve such services, and at the same time reduce the larval habitats of Aedes vectors as part of an overall effort at community development.
7. Combine dengue vector control with the control of all species of disease-bearing and nuisance mosquitoes as well as other vermin, to ensure greater benefits for the community and consequently greater participation in neighborhood campaigns.
8. Arrange novel incentives for those who participate in community programmes for dengue control. For example, a nationwide competition can be promoted to identify the cleanest communities or those with the lowest larval indices within an urban area.

The prevention and control of dengue requires close collaboration and partnerships between the health and non-health sectors (both government and private), nongovernmental organizations (NGOs) and local communities. During epidemics such cooperation becomes even more critical, since it requires pooling of resources from all groups to check the spread of the disease. Intersectoral cooperation involves at least two components:-
1. Resource-sharing
2. Policy adjustments among the various ministries and nongovernmental sectors.

Resource sharing:-

The dengue control programme should seek the accommodation or adjustment of existing policies and practices of other ministries, sectors, and municipal governments to include public health as a central focus for their goals. Research programmes in universities and colleges can be encouraged to include components that produce information of direct importance (e.g. vector biology and control, case management) or indirect importance (e.g. improved water supply, educational inter-ventions to promote community sanitation, waste characterization studies) to dengue control programmes.

The Ministry of Environment can help the Ministry of Health collect data and information on ecosystems and habitats in or around cities at high risk of dengue. Data and information on local geology and climate, land usages, forest cover, surface waters, and human populations are useful in planning control measures for specific ecosystems and habitats. The Ministry of Environment may also be helpful in determining the beneficial and adverse impacts of various Ae. aegypti control tactics (chemical, environmental and biological).

Information directed at the community at large is best achieved through the mass media, such as television, radio and newspapers. Therefore, the ministry responsible for information, communication and the mass media should be approached to coordinate the release of messages on the prevention and control of dengue developed by public health specialists.

NGOs can play an important role in promoting community participation and implementing environmental management for dengue vector control. This will most often involve health education, source reduction, and housing improvement related to vector control. Community NGOs may be informal neighbourhood groups or formal private voluntary organizations, service clubs, churches or other religious groups, or environmental and social action groups.

Health education is very important in achieving community participation. It is a long-term process to achieve human behavioural change, and thus should be carried out on a continuous basis. Even though countries may have limited resources, health education should be given priority in endemic areas and in areas at high risk for DHF. Health education is conducted through the different channels of personal communication, group educational activities, and mass media. Health education can be implemented by women's groups, school teachers, formal and informal community leaders, and health workers. Health education efforts should be intensified before the period of dengue transmission as one of the components of social mobilization. Th\e main target groups are school children and women.

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