Epidemiological Profile of Japanese Encephalitis in Nepal 1996 - 1997

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Abstract

In Nepal, during the past two decades, Japanese Encephalitis (JE) is known to occur mainly in southern terai districts of Nepal, but recently during 1996 and 1997, the Kathmandu valley particularly, the southern part of Lalitpur district first reported outbreak of JE, which was confirmed both serologically and virologically. Epidemiological surveillance study was carried out in all 18 JE endemic terai districts of Nepal during the months of November & December of 1996 and 1997 respectively. Results of epidemiological, entomological and serological investigation are presented, tabulated, analyzed and discussed. There was a total of 1687 cases with 353 deaths (21% Case fatality rate) in 1996 and a total of 1740 cases with 126 deaths (7% CFR) in 1997. All age & sex groups are infected with the disease, but below 15 years children were more prevalent with 21% & 7% CFR in male and 16% and 6% CFR in female children during 1996 and 1997 respectively. Whereas in adults, both male and female showed 23% and 25% CFR respectively. There is a seasonal difference in occuring diseases; the maximum number of cases appeared from June to October, and August was observed as a peak period during both years.

It has long been recognised that the feeding behaviour of Culicin mosquitoes is of paramount importance in the epidemiology of mosquito-borne JE pathogens. Host feeding pattern of vector mosquitoes is crucial for the maintenance of the complex natural cycle of JE virus, which includes pigs and birds and sometimes large animals like buffaloes and cattle. The virus is transmitted from pig to pig and bird to pig by Culex species of mosquito. The human beings are only incidental hosts of JE. The role of pigs and ducks as amplifier hosts is well established in Nepal as well as in other southeast Asian countries. Except dog *Cx. vishnui* was found to feed on man, cattle, buffalo, pig, bird and goat, showing its wide range of feeding. Among them bovids were found to be preferred hosts after pigs and ducks. Pigs and ducks possess a high body temprerature and attract a large number of mosquitoes, thus maintaining the pig-mosquito-pig cycle, duck-mosquito-duck-mosquito-pig cycle. In Nepal, in recent outbreaks of 1996 and 1997, the feeding behaviour of mosquito on bovid in the endemic areas, where there are no pigs and ducks population, has been observed. This means the epidemiological pattern of the disease transmission could be buffalo-mosquito-buffalo and cattle-mosquito-cattle cycle with more contact with humans infection through vectors. JE virus isulation studies in the endemic areas from mosquitoes, animals and diseases human beings are needed to confirm this hypothesis.

The prevention and control of JE has been a challenging problem in view of non-availability of effective chaemoprophylaxis against the virus and limitations of immuno-prophylaxis. There have been attempts for effective prevention and control of JE by malathion spraying, directing the control measures against the vectors-Culicine mosquitoes. However, this approach too has its own limitation because the known vectors of JE in Nepal namely Culex species mainly breed in large paddy fields and ponds limiting the effectiveness and feasibility of the larval control. JE virus transmission is from domestic animals and birds as reservoirs because the JE virus in nature is found in pigs, birds and large animals like water buffaloes and cattle. In Nepal pigs and ducks have been found as the main reservoirs of JE virus. In the present senario, the epidemiology of JE has undergone considerable changes over the last two decades. There are no reports of antibodies in 'sentinel' pigs from terai districts of the country. Therefore, seroconversion profile of sentinel pigs and birds with its relation to endemicity pattern of JE in Nepal must be carried out urgently. The human cases of JE have been known to occur between mid June to mid October with peaks in August and September. Therefore, the JE transmission period epidemiologically can be considered as July to October with a peak on September.

The present study has revealed that the JE situation in Nepal from 1978 onward showed increasing trend in the incidence of JE from the human population point of view, coverage of geographical area, seasonal occurance, vector bionomics, animal reservoir hosts and environmental and climatic changing effects. Since it is a vector-borne viral zoonotic disease, so far Culicine mosquitoes species viz. *Culex tritaeniorhynchus*, *Cx. vishnui*, *Cx. pseudovishnui*, *Cx. gelidus* and *Cx. fuscocephalus* have been incriminated and identified as vectors of JE. The female mosquitoes are known to feed on a wide range of vertebrates including man. Whereas some Culicine species have a restricted host range and distinct feeding preferences. JE is a viral zoonotic disease transmitted by mosquito vector bite and

caused by arbovirus (flavivirus) which affects the central nervous system. The virus is maintained in nature in animals reservoirs like pigs, cattle and birds. This disease was first recognised in Japan in 1924 and in the Indian adjoining border of southern terai districts of Nepal, Gorkhpur district of Uttar Pradesh in 1978. Since then the JE has become a major public health problem in all Terai districts of Nepal since 1978. The current epidemiological survey study has revealed that both the ricefields and the ponds situated in every endemic villages are chiefly contributing towards the population density of Culicine mosquitoes. In view of recurrent outbreaks in Terai districts and widespread breeding places of mosquitoes, there is an urgent need to asses the feasibility of suitable vector control measures including antilarval operations and ultra-low volume application of insecticides in all the affected endemic districts.

Keywords: amplifier host; chemoprophylaxis; immuno-prophylaxis.

Background Information of Nepal

Nepal is divided into five development regions with fourteen zones which are further divided into 75 districts; these districts have 33 municipalities and 4,200 Village Development Committees (VDC) administratively. The total human population is about 20 million (CBS, 1994). The geographical distribution of Japanese encephalitis during 1978-1997 is presented in table I.

Epidemiological Profile of JE

Japanese encephalitis (JE) is a serious acute mosquito-borne (Culicine mosquitoes) viral zoonotic disease and is endemic in most of the Far east, South East Asia and South Asia including Nepal. The first indication of JE transmission in Nepal was from northern India (Bihar, Uttar Pradesh and West Bengal states) where an apparent Japanese encephalitis outbreak was reported for the first time. Outbreaks recurred exclusively in south India from 1948 until 1978 (Sehgal, P.N. 1989 and Joshi 1981 and Khatri *et al*., 1981, Parajuli *et al*., 1992).

Children aged five to fifteen are the main victims. The case fatality rate (CFR) is high in Nepal, and nationwide it has ranged between 15% to 46% for the years 1978 to 1994. About fifty percent of the JE survivors are left with neurological syndrome and damage to the organs. Epidemics in Nepal have been recorded since 1978 and the virus has been isolated from pig and human cases of JE in the eastern Tarai (lowlands) of Nepal (Joshi *et al*., 1995, Khatri *et al*., 1981, 1983). JE virus causes encephalitis in humans and horse and abortions in pigs and no symptoms in other animals and birds. JE virus is an enveloped RNA virus, small in size, approximately 50 nm in diameter and belongs to the family Togaviridae and the genus *Flaviviridae* (Tsai, *et al*., 1993 and Burke, 1988, Bhardwaj et. al. 1981, Bista et. al. 1993, Seghal 1989). The JE incidence appears to be subsiding in Japan, China (PRC) and the Republic of Korea, but it has been increasing and is endemic in India, Thailand, Sri Lanka, Bangladesh, Myanmar (Burma), Viet Nam, Malaysia, Indonesia, Laos, Cambodia, Taiwan and Nepal (Joshi 1981, 1983a).

Epidemiological Surveillance Study

A team from NZFHRC conducted an epidemiological surveillance study in all 18 endemic terai districts of JE during 1996 and 1997 outbreaks. All – the nationwide morbidity, mortality, seasonal occurance, JE vectors information and animal reservoirs situation were collected, analysed, tabulated and presented in this report. Nationwide Case Fatality Rate of Japanese Encephalitis from 1978 to 1997 is presented in table I and in fig. 1,2,& 3.

Table I : Nationwide Case Fatality Rate of Japanese Encephalitis, 1978-1997

Year	*Cases*	*Deaths*	*CFR%*
1978	422	119	28
1979	182	49	27
1980	622	231	37
1981	54	16	30

1982	843	390	46
1983	243	36	15
1984	142	45	32
1985	597	146	24
1986	1,299	357	27
1987	338	69	20
1988	1,108	188	16
1989	868	227	26
1990	358	129	36
1991	276	105	38
1992	517	182	35
1993	394	125	32
1994	1,029	170	17
1995	1,242	197	16
1996	1,687	353	21
1997	1,740	126	7
Total	13,961	3260	23.35

Fig. 1: Nationwide Death Cases of Japanese Encephalitis of Nepal (1978-1997)

Fig. 2: Nationwide Total Cases of Japanese Encephalitis of Nepal, 1978-1997

Fig. 3: Nationwide Case Fatality Rate of Japanese Encephalitis of Nepal, 1978-1997

Age & Sexwise Japanese Encephalitis Cases :

Age & Sexwise Japanese Encephalitis cases recorded in Nepal for the 1996 and 1997 are presented in table II and fig. 4 & 5. 0-5 year children group has more cases of JE than adults, however, there is no sex difference in both male and female cases. There is high mortality (21%) in male children compared to female (16%).

Table II: Age & Sexwise Japanese Encephalitis Cases Recorded in Nepal

	1996				1997			
Age & Sex	*Total Cases*	*%*	*Death*	*CFR*	*Total Cases*	*%*	*Death*	*CFR*
0 - 15 Male	536	32	112	21	675	39	45	7
0 - 15 Female	435	26	71	16	475	26	29	6
16 & above Male	435	26	101	23	293	17	29	10
16 & above Female	281	16	69	25	297	17	23	8
Total = >	1687	100	353	21	1740	100	126	7

Fig. 4: Age & Sexwise Japanese Encephalitis Cases Recorded in Nepal 1996

Fig. 5: Age & Sexwise Japanese Encephalitis Cases Recorded in Nepal 1997

Fig. 6: Monthwise Japanese Encephalitis Cases Recorded in Nepal 1996

Monthwise Japanese Encephalitis Cases

Monthwise Japanese Encephalitis cases recorded in Nepal for the year of 1996 and 1997 are recorded and tabulated in table III and fig. 6 & 7. The peak season of JE cases is mostly observed between the months of Mid June and Mid October. August and September are the main months of JE outbreaks in the country. This is because of monsoon rain, high density of mosquitoes population, less population of pigs and birds to feed on by mosquitoes.

Table III: Monthwise Japanese Encephalitis Cases Recorded in Nepal

Month	1996					1997				
	Male	*Female*	*Total*	*Death*	*CFR*	*Male*	*Female*	*Total*	*Death*	*CFR*
Jan.	11	10	21	1	5	-	-	-	-	-
Feb	4	10	14	1	7	-	-	-	-	-
March	7	8	15	2	13	-	-	-	-	-
April	16	12	28	4	14	30	11	41	4	10
May	17	17	34	5	15	38	31	69	5	7
June	12	8	20	9	45	23	19	42	5	12
July	16	7	23	11	48	118	38	156	15	10

Aug	85	46	131	16	12	502	255	757	69	9
Sept.	293	164	457	65	14	294	310	604	9	1
Oct.	183	140	323	75	23	32	30	62	17	27
Nov.	176	138	314	79	25	6	3	9	2	22
Dec	171	136	307	85	28	-	-	-	-	-
Total	991	696	1687	353	21	1043	697	1740	126	7

Fig. 7: Monthwise Japanese Encephalitis Cases Recorded in Nepal 1997

Animal Reservoir

Animal Population for JE Virus Reservoir in Nepal is presented in table IV. The JE vector Culicine mosquitoe, is a zoophilic, which mainly feeds on pigs, horses and birds, sometimes on large animals like cattle, buffalo, sheep and goat. It has been serologically proved that animals serum of pigs and ducks are the main reservoir for JE virus in Nepal. However, isolation of JE virus from the animals has not been carried out yet, but viremia in animals due to JE virus has been studied in the endemic area like Sunsari and Morang districts (Joshi et. al. 1990, Sanyal et. al. 1979).

Table IV: Animal Population for JE Virus Reservoir in Nepal (in thousands)

Animal	*Mountains*	*Hill*	*Terai*	*Nepal*
Horse/ Mules	128	112	18	258
Pigs	76	320	152	548
Ducks	16	58	283	357

Source: DFAMS and CBS

Vectors of Japanese Encephalitis Recorded in Nepal

Rice field mosquitoes of the genus *Culex* were the main vectors transmitting the disease. Entomological studies were carried out during the outbreak. Forty-one species of mosquitoes have been identified in the affected areas. These mosquitoes generally feed on mammals and birds (zoophilic) but sometimes on humans when they do not find animals. Feeding time for the mosquitoes is generally the first hour after sunset. They remain infected with the virus their whole lives. They breed mainly in irrigated rice fields but also other places like shallow ditches, ponds and pools. At least forty-one species of mosquitoes have been identified in the affected areas including the following main JE vectors (Pradhan 1981 and 1982, Regmi et. al. 1985) :

Culex bitaeniorhynchus Culex epidesmus

Culex fuscocephalus Culex gelidus

Culex tritaeniorhynchus Culex vishnui complex

Culex whitmorei Aedes albopictus

Anopheles hyrcanus Armigeres group

Mansonia group

Conclusion

Future activities to control Japanese Encephalitis are mentioned below:

1. More and continuous epidemiological surveillance study.

2. Isolation of indigenous Japanese encephalitis virus strains from human, vector and animals and birds.

3. Immunization against Japanese encephalitis in pigs and horses in endemic areas especially in breeding stocks reared by either government or by private sectors.

4. Immunization against Japanese encephalitis in children below five years of age in all endemic areas.

5. Control of vectors and animal reservoirs.

6. Mass awareness and public education campaigns.

7. Improvement of animal husbandry and rice cultivation.

8. Improve hygiene and sanitation in and around rural and urban areas, housing complexes, roads, water supply, drainage, garbage disposal, ponds and toilets.

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