

# RECENT OUTBREAKS OF JAPANESE ENCEPHALITIS IN BURMA

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## INTRODUCTION

Outbreaks of Japanese encephalitis (JE) have not been reported in Burma. A premonsoon serological survey carried out in 2 areas in Rangoon in 1968 showed that 16% of the sample population had detectable JE neutralizing antibody (CEU, 1968, unpublished data). JE has been suspected in Rangoon but a serological study on suspected hospitalized cases failed to confirm it (C. Khai Ming and Than Swe, pers. comm.). Unexpectedly a small JE outbreak was reported in Tachileik township in July 1974 for the first time in the country (Thaung *et al.*, 1975a), and subsequently outbreaks were reported in other parts of the Shan State in 1975 (Khai Ming *et al.*, 1975, unpublished report; Directorate of Medical Services, Ministry of Defence, 1976, unpublished report).

This communication describes seroepidemiological aspects of recent outbreaks in Burma.

## MATERIALS AND METHODS

**Epidemiology:** Tachileik and Kengtung towns are located in the eastern Shan State, while Lashio is in the northern Shan State as shown in Fig. 1. Tachileik is a small border town on the western bank of Maesai River. JE is known to be endemic in Chiangmai Valley in Thailand (Grossman *et al.*, 1973) which has a direct land road to Tachileik. Kengtung is about 100 miles northwest of Tachileik. Lashio is located at 22.58°N latitude and 98.51°E longitude and is situated

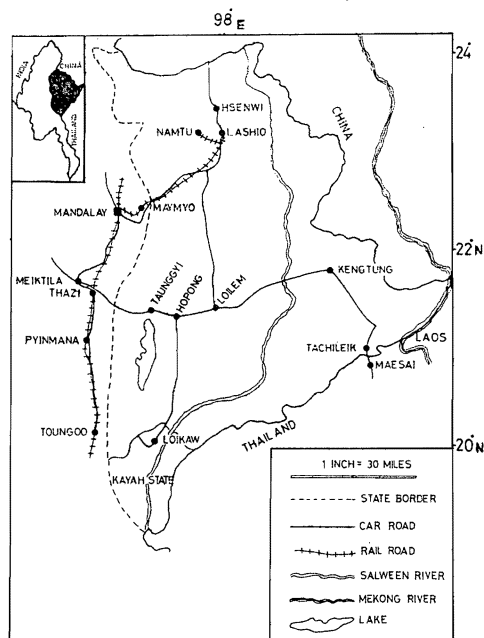


Fig. 1—Map of Shan State.

at an elevation of 2,806 feet above sea level. Being a commercial town, there is a direct road to Taunggyi, capital city of the Shan State, in the south, Kengtung and Tachileik in the southeast and Mandalay in the west. There is a regular air service with different parts of the country.

The first JE outbreak was reported in Tachileik township in July 1974 when there were 5 cases with 4 deaths as shown in Table 1. All of these cases occurred in July. The outbreak spread to Lashio and Hsenwi and Kengtung townships in 1975. The outbreak in Lashio and Hsenwi townships lasted for almost 3 months - August to October - involv-

Table 1

Incidence of hospitalized cases of Japanese encephalitis in Burma, 1974-1975.

Year	Reporting hospitals	No. cases	No. deaths	CFR
1974	Tachileik	5	4	80.0
1975	Lashio	23	17	73.9
	Kengtung	19	15	78.9
	Loikaw	1	0	0.0

CFR = Case Fatality Rate.

ing 23 cases with 17 deaths. The outbreak in Kengtung occurred in September and October when there were 19 cases with 15 deaths. Four of the cases in Tachileik township and 11 of the cases in Lashio and Hsenwi townships were from rural villages. In Kengtung, most of the cases (15) occurred in cantonment area just out of town.

Table 2 shows the age distribution of clinically diagnosed cases of JE in Tachileik, Kengtung, Lashio and Hsenwi townships. In Tachileik, Lashio and Hsenwi townships all ages were involved while only children up to 10 years were involved in Kengtung. In all townships no infants under one year of age were affected. In Lashio, the case fatality rate was highest in the older age groups. The case fatality rate ranged from 73.9% in Lashio to 80.0% in Tachileik.

Entomological surveys carried out during the outbreaks in Tachileik and Lashio towns showed that there were numerous *Culex tritaeniorynchus*. These mosquitoes were caught both in human dwellings and animal houses. No attempt was made to isolate virus from the mosquito specimens due to lack of laboratory facilities.

As soon as the outbreaks were recognized, an intensive mosquito control programme was undertaken by the local health staff under the technical supervisions of the central staff. This consisted of health education of the population on the methods of, and the importance of, mosquito control by means of sound trucks, and by group talks in cooperation with the local administrators, general cleansing campaign and fogging with insecticides.

Table 2

Age distribution of clinically diagnosed cases of JE in Tachileik, Kengtung and Lashio, 1974-1975.

Age group	Lashio			Kengtung			Tachileik		
	Cases	Deaths	CFR	Cases	Deaths	CFR	Cases	Deaths	CFR
0-1	0	0	0.0	0	0	0.0	0	0	0.0
1-4	1	0	0.0	12	10	83.3	0	0	0.0
5-9	7	4	57.1	6	4	66.6	2	1	50.0
10-19	9	7	77.7	1	1	100.0	2	2	100.0
20-39	5	5	100.0	0	0	0.0	1	1	100.0
40+	1	1	100.0	0	0	0.0	0	0	0.0
Total	23	17	73.9	19	15	78.9	5	4	80.0

CFR = Case Fatality Rate.

## RESULTS

**Clinical manifestations:** The clinical manifestations of 23 cases clinically diagnosed at the Divisional Hospital, Lashio are summarized in Table 3. In all cases the disease began with sudden onset of fever with severe headache. There was a rapid rise of temperature to high level of 106°F to 107°F, often with marked restlessness and irritability. Nuchal rigidity was the commonest manifestation, especially in children and it was observed in 60.8% of all cases, while paresis or paralysis was the commonest cerebral involvement and was observed in 56.5%. Expressive aphasia developed in 21.7% of all cases. Coma usually set in on the 3rd or 4th day of the onset of the disease. It deepened towards the terminal stage and the patient usually died within the first week. 52.9% of the cases died within 6 days of onset. Four of the children under 12 years of age improved in their level of consciousness slowly and regained mobility of limbs gradually. However, nuchal rigidity and spasticity of the limbs persisted for a long time. Mental picture was completely normal on recovery in all survivors

Table 3

Some clinical manifestations of 23 cases of Japanese encephalitis at the Divisional Hospital, Lashio, 1975.

Manifestations	No. patients	Per cent
High fever	21	91.2
Neck rigidity	14	60.8
Paresis or paralysis	13	56.5
Coma	10	43.4
Fits	9	39.1
Restlessness	6	26.0
Aphasia	5	21.7
Semiconsciousness	4	17.3
Confusion	1	4.3
Disorientation	1	4.3

under 12 years of age. On the other hand 2 of the patients over 12 years old had marked behaviour disturbance and mental retardation on recovery.

**Serological investigations :** The diagnosis of JE was serologically presumed in a convalescent case which occurred in the outbreak in Tachileik township in July 1974. A convalescent serum sample was obtained from the only surviving patient which showed dengue HI antibody at 1:320 and that of JE titre at 1:640. The plaque reduction neutralization test carried out on the same serum by Dr. Halstead in Hawaii showed at 1:80 titre against JE. The diagnosis of JE was serologically confirmed in Lashio in 1975 by the demonstration of a fourfold or greater rise in titre of haemagglutination-inhibition test in a set of paired sera obtained from a clinically diagnosed case. No virus isolation was attempted since there were no laboratory facilities. However, serological studies were carried out on 111 apparently healthy population and 38 contacts of the patients and 38 various animals in Lashio. 77 contacts of the patients and apparently healthy population in Kengtung and 50 apparently healthy school children in Loikaw were also studied serologically. The latter study was carried out as a follow up serological survey for dengue which was also included in this communication.

**Haemagglutination inhibition test :** The microtitre haemagglutination-inhibition test (HI) was the standard serological procedure used (Clarke and Casals, 1958 and Sever, 1962). Eight units of each haemagglutinating antigens were used in the simultaneous testing for JE (Nakayama and Peking); Dengue-(Haw); Dengue-2 (NGC); Dengue-3 (633798); Dengue-4 (H241) and West Nile virus antibodies in Lashio and Kengtung, employing twofold serum dilutions starting at 1:10 dilution. JE, dengue or West Nile titres of 1:10 were considered detectable antibody titres to the respective antigen and a titre of

Table 4

HI antibodies prevalence to dengue, JE and WN among apparently healthy population in Lashio, Kengtung and Loikaw, Oct.-Dec. 1975.

Town	No. tested	Per cent HI antibodies prevalence to:		
		Dengue	JE	WN
Lashio	111	19.8	23.4	17.1
Kengtung	77	53.2	66.2	83.1
Loikaw	50	84.0	48.0	N.D.

N.D. = Not done.

4-fold rise in paired sera was considered to be evidence of a significant titre level.

The prevalence of HI antibodies to dengue, JE and WN among apparently healthy population in Lashio, Kengtung and Loikaw is presented in Table 4. The per cent antibodies prevalence to dengue, JE and WN in Lashio was: 19.8, 23.4, and 17.1 respectively and in Kengtung the per cent prevalence was: 53.2, 66.2 and 83.1 respectively. The per cent antibody prevalence to dengue in Loikaw was 84.0 and that for JE was 48.0.

Table 5 shows the percentage of contacts of JE and apparently healthy population tested

in Lashio who reacted to a titre of at least 1:10 in the HI test to one or more of group B arboviruses. There were 38 contacts of the patients and the 111 apparently healthy people of various age groups whose sera were tested. Among contacts of the patients the overall per cent antibody prevalence to JE and dengue was 57.8 and 60.5 respectively. The cent per cent JE seropositivity rate was highest in the 30 - 39 year age group while dengue was highest in the 15 - 19 year age group. No antibody to both viruses was detected in the 0 - 4 year and 50 years and older age groups. Among the apparently healthy population, the overall per cent anti-

Table 5

Prevalence of JE and dengue HI antibodies by age, in Lashio, Oct. 1975.

Age group	Contacts of patients			Apparently healthy population		
	No. tested	Per cent positive		No. tested	Per cent positive	
		JE*	Dengue		JE*	Dengue**
0-4	6	0.0	0.0	19	21.0	21.0
1-9	5	60.0	80.0	23	13.0	17.3
10-14	3	33.3	33.3	13	0.0	7.6
15-19	4	75.0	100.0	11	27.2	9.0
20-29	9	66.6	77.7	13	38.4	38.4
30-39	3	100.0	66.6	11	27.2	9.0
40-49	8	75.0	62.5	9	22.2	22.2
50+	0	0.0	0.0	12	50.0	33.3
Total	38	57.8	60.5	111	23.4	19.8

\* HI titres  $\geq$  1 : 10.

\*\* HI titres  $\geq$  1 : 10 to one or more of 4 dengue serotypes.

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body to JE and dengue was 23.4 and 19.8 respectively. Except in the 10 - 14 year age group both antibodies to the viruses were detected in all age groups and the 50% antibody positivity rate was highest in the 50 years and older age groups. Both JE and dengue affected more contacts of the patients than the apparently healthy population, 2.4 times for JE and 3 times for dengue.

The actual JE and dengue titres present in each person's serum are shown in Table 6. 8 (26.6%) of the 30 people who had detectable group B arbovirus titres had monospecific JE titres while 6 (20.0%) had monospecific dengue titres. Of the remaining 16 people who had detectable group B arbovirus titres, 2 (12.5%) had JE titres more than fourfold, 1 (6.2%) had JE and dengue titres less than

Table 6

Distribution of HI titres to JE and dengue (highest 1-4 titres) among apparently healthy population, Lashio, October, 1975.

JE titres	Highest dengue 1-4 titres							Total	Per cent
	<10	10	20	40	80	160	320		
<10	76	3	1	2				82	77.3
10	2	4	2	1				9	8.4
20	3		1	1	1			6	5.6
40	3			1				4	3.7
80		2		1				3	2.8
160		1						1	0.9
320							1	1	0.9
Total	84	10	4	6	1		1	106	
Per cent	80.1	9.4	3.7	5.6	0.9		0.9		100.0

Note: Total samples serologically studied 111 out of which 3 had cross reaction with JE and WN while 2 had dengue and WN.

Table 7

Distribution of HI titres to JE and dengue-1 in horses, mules, pigs and geese, Lashio, October 1975.

JE titres	Dengue-1 titres							Total	Per cent
	< 10	10	20	40	80	160	320		
<10	7							7	18.4
10	3							3	7.8
20	5	3						8	21.0
40	1	1	1					3	7.8
80	3	2						5	13.1
160	3		4	1				8	21.0
320			2		1	1		4	10.5
Total	22	6	7	1	1	1		38	
Per cent	57.8	15.7	18.4	2.6	2.6	2.6			100.0

fourfold apart; only 2 (12.5%) had dengue titres fourfold higher. No age play an important role in the distribution of persons with detectable group B arbovirus titres whose titres were monospecific to either JE or dengue.

Table 7 shows the actual JE and dengue titres present in each animal's serum. All of the samples tested had higher antibody titre to JE than dengue. 15 (48.3%) of the animals which had detectable group B arbovirus antibody titres had monospecific JE titres. Animals with monospecific titres to JE should have been lower had all dengue serotypes been tested. There were 38 animals tested out of which 78.9% of them showed detectable antibody to JE as shown in Table 8. All of the horses and mules tested had detectable antibody to JE while only 73.0% of the pigs had detectable antibody.

Table 8

Prevalence of HI antibody to JE in animals in Lashio and Hsenwi townships, October, 1975.\*

Animal	No. tested	Per cent antibody prevalence
Horses	6	100.0
Mules	5	100.0
Goose	1	100.0
Pigs	26	73.0
Total	38	81.5

\*HI titres  $\geq$  1:10.

## DISCUSSION

Based on the serological findings, clinical comparability of the cases with JE, the presence of probable vector mosquitoes and the existence of endemicity of JE in Chiangmai Valley in Thailand, the outbreak in Tachileik township can be concluded as JE. The sub-

sequent outbreaks of JE in 3 townships in 1975 indicated that it has now been confirmed in the country.

Though JE occurs sporadically in tropical countries, the occurrence of epidemic form in the Shan State is of interest. Whether this phenomenon is a result of its subtropical climate need further study.

The involvement of only children in Kengtung outbreak will require study in future. A retrospective investigation carried out by one of the authors (CKM) indicated that at least 2 adults were also involved in the outbreak. The absence of adult cases in this outbreak was thought to be due to failure to recognize by the local health department which concentrated its efforts on children. The diagnosis of JE cases in Kengtung was first confused with pyogenic meningitis as the latter frequently occurred in the military cantonment in the past (Directorate of Medical Services, Ministry of Defence, 1976, unpublished report).

The interpretation of serological results is greatly complicated by the presence of at least 3 closely related and serologically cross reacting group B arboviruses. The existence of JE and WN viruses in rural areas has been expected in the past. The serological survey carried out in Lashio in 1973 showed 6% prevalence of dengue infection in children under 10 years (Thaung *et al.*, 1975b). Unfortunately, no other group B viruses were investigated in the survey at that time. Taking 6% antibody prevalence to group B arboviruses as a base, there is definitely about 4-fold increase of these infections in 2 years.

The higher prevalence rate of both dengue and JE viruses in contacts of JE cases is expected. The presence of monospecific antibody titres to these viruses in contacts of the patients revealed simultaneous transmission of both viruses during the outbreak in Lashio. This is confirmed by the concurrent outbreak

of dengue haemorrhagic fever and JE among children in Lashio (Khai Ming *et al.*, 1975, unpublished report).

In analyzing the HI data in the 111 sera collected during the outbreak in Lashio in October 1975, it was assumed that people with monospecific JE titres had previously been infected by JE alone and that low levels of accompanying dengue antibody in people with higher JE titres were cross reacting rather than "real" dengue HI antibody. Similarly, people with monospecific dengue HI titres were assumed to lack a previous JE infection. Similar findings were reported in Thailand (Grossman *et al.*, 1973).

The high prevalence of JE HI antibody in pigs is of interest. A similar survey carried out on pigs brought to Rangoon from various parts of the country for slaughter also showed a high prevalence to JE HI antibody but comparatively low antibody prevalence was observed in cattle and buffaloes, especially in the latter (Than Swe, 1974, pers. comm.). Pig is a common domestic animal in Burma. In rural villages and small towns this animal is bred in almost every back yard or underneath a house. Pig is said to be an amplifying host in Japan (Kono and Kim, 1969). Therefore, pigs may play an important role in the transmission of the infection in man in this country. Recently a small outbreak was reported among horses in Rangoon (Mya Sein, pers. comm.). But it is not known whether there is any relationship between the outbreak in horses in Rangoon and other parts of the country.

The seroepidemiological study in Lashio shows that both dengue and JE infections are not yet widespread in the community and that more outbreaks can be expected, especially the latter, in the future.

## SUMMARY

Outbreaks of JE were reported recently in at least 4 townships in the Shan State of Burma. The first outbreak occurred in Tachileik township in July 1974 where there were 5 cases with 4 deaths; another and more extensive outbreak occurred the following year in Kengtung, Lashio and Hsenwi townships. In all there were 42 cases with 32 deaths. In Tachileik, the outbreak occurred only in July while in the remaining areas it occurred from August to October. Most of the cases were reported from villages or from sections of a town with rural type environment. In Kengtung 15 out of 19 cases occurred in the military cantonment area just outside of town.

All ages were involved in these outbreaks except in Kengtung where only children were reported. The specific age involvement in the latter was thought to be due to selective age admissions. The case fatality rate increased with age. No deaths were reported under one year of age. The overall case fatality rate in these outbreaks was 76.5%.

The outbreak in Tachileik township was serologically presumptive while it was confirmed in Lashio. No serological investigation of the clinical cases was carried out in Kengtung. A serological study on 38 contacts of the patients in Lashio showed that the overall per cent HI antibody prevalence to JE and dengue was 57.8 and 60.5 respectively while in the 111 apparently healthy people the HI antibodies prevalence rates were 23.4 and 19.8 respectively. Both JE and dengue affected more contacts of the patients than those of the apparently healthy individuals, 2.4 times for JE and 3 times for dengue.

A serological study among various animals in the areas showed a high prevalence of JE HI antibody.

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