Int J Biol Med Res. 2011; 2(3): 691-695

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International Journal of Biological & Medical Research

Journal homepage: www.biomedscidirect.com

Original Article

Epidemiological aspects of japanese encephalitis in bellary, karnataka, India

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ARTICLE INFO

Keywords:
Japanese encephalitis
MAC ELISA

ABSTRACT

Background: A study was conducted in VIMS hospital at Bellary during the epidemic of August 2004 to July 2005. Objectives: To know the association of Japanese encephalitis occurrence with epidemiological factors. Materials and methods: 82 children admitted to the Paediatric ward, VIMS, Bellary with clinical diagnosis of acute viral encephalitis, during the epidemic of August 2004 to July 2005 were studied. After pooling the samples, they were subjected to J.E. MAC ELISA. The association of epidemiological factors with both suspected cases as well as the positive cases was studied. Results: In this study the role of epidemiological features involved in J.E. is well documented. Both the suspected patients as well as the serologically confirmed cases of Japanese encephalitis were more associated with living in rural areas with unhygienic living conditions. Many of them were from the low socio economic group. More number of J.E. cases and flaviviral infections occurred in the rainy season followed by in the winter season. Conclusion: J.E. is the most common form of sporadic and epidemic encephalitis in the tropical regions and should be ruled out first before considering the other viral causes. Illiteracy, low socio economic status and living in unhygienic conditions near rice fields contributed to the high incidence of J.E. in and around Bellary. Residents in endemic areas should take personal protection to reduce the number of mosquito bites. The peak incidence of J.E. is seen from October to December which is the post monsoon period in the area of study.

1. Introduction

J.E. is a disease of major public health importance due to its high epidemic potential, high case fatality rate (CFR) and sequelae among survivors. Approximately 3 billion people (60 % of the world's population) live in J.E. endemic regions [1]. The disease causes 35,000 cases of encephalitis and 10,000 deaths each year, and about 30% of survivors develop serious permanent sequelae [2]. JEV has gained importance as a human pathogen with an increasing frequency of epidemics and outbreaks in many parts of India and Southeast Asia, since last three decades [3]. A recent estimate states that 378 million individuals are exposed to the risk of becoming infected with JEV in India [4]. J.E., a disease with a very high mortality and morbidity has emerged as a major public health problem in the country since 1973. Encephalitis caused by JEV was restricted to Southern India before the seventies. Since 1973, epidemics of J.E. have occurred in West Bengal, Bihar, Uttar Pradesh, Assam, Andhra Pradesh, Tamil Nadu and Karnataka [5]. Altogether, there have been 29,300 deaths due to J.E., and the overall CFR is 34.5% and ranged from 19.84% (2000) to 51.6% (1994). The area specific CFR ranged from 0 to 55.5% in the different districts or states during the period 1998 to 2002 [1]. JEV is transmitted to man by the bite of an infected mosquito. It is a zoonotic disease, i.e. the virus is maintained in nature by a complex natural cycle involving vertebrate species which act as reservoirs. Man is only occasionally infected and is a “dead end” since viremia in human blood is too low and transient to infect mosquitoes. Serological and experimental studies have shown that birds of the

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family, Ardeidae, which include herons and egrets, play a role in maintaining the virus in nature. Pigs are important amplifying hosts for JEV in all countries where the disease occurs [6]. Cattle and buffaloes are the preferred hosts for J.E. vector mosquitoes, but they do not circulate the virus and therefore do not play a role in its maintenance and spread, but act as "dampers" in the cycle. Therefore the presence of cattle may reduce the risk of infection to humans [6]. JEV undergoes secondary amplification involving replication in live stock animals resulting in greater levels of spill over to humans in rural settings. Two of the most important human arboviral pathogens, Yellow fever and DEN viruses have gone one step further and adopted humans as their amplification hosts allowing for urban disease [7]. Persons with J.E. generally come from homes in close proximity to paddy fields which afford sites for abundant mosquito breeding. Usually there may have also been close contact with live stock including cattle and pigs. Mosquitoes of the Culex (Cx) vishnui complex and particularly *Cx tritaeniorhynchus,* all rice field breeders, appear to be the important vectors of J.E. in South India [8-10].In a study conducted by G Geevarghese et al; it has been shown that Cx tritaeniorhynchus is the most important vector in the country. In addition other species like *Cx vishnui, Cx pseudovishnui, Cx whitmori, Cx bitaeniorhynchus, Cx epidesmus, Cx fuscocephala,* Cx gelidus etc may be playing an important role as vectors in different endemic areas. In Bellary district, *Cx. tritaeniorhynchus* was the most abundant species [9]. In South India, a basic pig-mosquito-pig-virus cycle occurs with the occasional involvement of man. The possibility, however, of a completely different and as yet unrecognised cycle must be kept in mind [8]. The vectors of JEV breed in rice field water. Mosquito density begins to rise with extensive paddy planting at the start of the rainy season in July-August. This corresponds with the breeding season of the Ardeid birds in certain localised pockets. Virus transmission among pigs begins, and reaches its peak in September. Large numbers of infected mosquitoes have been detected at this time. The peak in human cases follows in October- November [6].

Objectives:

1. To study the relationship of epidemiological factors with the occurrence of J.E. in Bellary.
2. To the study the seasonality of the disease.

2. Materials and Methods

The study group consisted of 82 patients clinically diagnosed as acute viral encephalitis and admitted to the department of Paediatrics, VIMS, Bellary. The study was conducted over a period of one year from August 2004 to July 2005. After taking the consent of the parents the patients were worked up as per proforma. Patients diagnosed clinically as viral encephalitis, whose CSF and serum samples were sent for confirmation to Microbiology laboratory for antibody detection were included in the study. Specimen collection and transport were considered as of paramount importance in the laboratory confirmation. 2-3 ml of CSF was collected by lumbar puncture after ruling out papilledema by the Paediatrician. 2-5 ml of blood samples were collected by venipuncture.10 Both samples were transported to the Microbiology laboratory in vaccine carriers. After receiving the CSF and blood samples along with the duly filled requisition forms from the Paediatric department, serum was separated by centrifugation of the whole blood sample. The CSF and serum samples were transferred to sterile aliquots, labelled with the particulars of the patient and preserved in the refrigerator at 4oc. A register was maintained in which the particulars of the patient were entered. The MAC ELISA was performed using a commercial kit; JEV CHEX procured from X-CYTON diagnostics, marketed by NIMHANS, Bangalore, NII, New Delhi and KGMC, London. The co-relation of various epidemiological factors with the suspected end positive cases was than studied.

3.Results:

The present study was carried out in the department of Microbiology, VIMS, Bellary and comprised of 82 clinically diagnosed cases of acute viral encephalitis. The study involved 49(59.75%) males and 33 (40.25%) females. In this study, out of the 82 patients tested by J.E. MAC ELISA, 19 (23.17%) were positive for J.E., 12 (14.63%) were positive for flaviviral infection and 51 (62.20%) were negative for J.E. Out of the 82 CSF samples tested, 19 (23.17%) were positive for J.E., 1 (1.22%) was positive for flaviviral infection and 62 (75.61%) were negative for J.E. Out of the 63 serum samples tested, 10 (15.87%) were positive for J.E., 11 (17.46%) were positive for flaviviral infection and 42 (66.67%) were negative for J.E.

Figure 1. In this study the role of epidemiological features involved in J.E. is well documented. Out of 82 patients studied, 65 (79.3%) were from rural areas and 17 (20.7%) were from urban areas. Out of the 82 patients studied, 68 (82.9%) children gave H/O staying in unhygienic areas like paddy fields which act as breeding places for mosquitoes while 14 (17.1%) children did not have such history.

Figures And Illustrations

Fig 1. Result of J.E. Maelisa

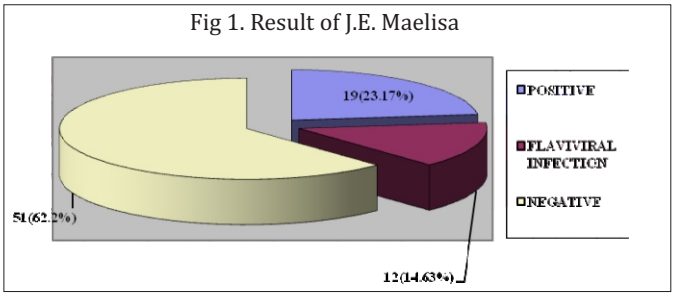


Table 1: Association Of Cases With Place Of Occurrence And H/o Staying Near Breeding Places.

Place of Occurence	Cases	H/O Staying Near Breeding Places	No H/o Staying Near Breeding Places
Rural	65	53 (81.5%)	12 (18.5%)
Urban	17	15 (88.2%)	2 (11.8%)
Total	82	68 (82.9%)	14 (17.1%)

The above table shows that more number of J.E. cases and flaviviral infection occurred at rural areas (38.46%). The difference in the percentage of cases does not differ statistically (chi- square= 0-0016, p> 0.05).

In this study, out of 82 patients studied all had history of (H/O) having contact with domestic animals (pigs, cattle or birds-chicken) which are reservoir hosts for J.E. 48 (58.6%) had H/O contact with pigs, 23 (28%) had H/O contact with cattle and 11(13.4%) had H/O contact with chicken. Out of 82 patients studied, 66 (80.5%) had no H/O taking mosquito prophylaxis, while 16 (19.5%) gave H/O taking mosquito prophylaxis either in the form of coils or repellents. 15 (18.3%) gave H/O using coils while 1 (1.2%) gave H/O using repellents.

In this study, out of 82 patients studied, 63 (76.8%) were from low socio economic group with income less than 400 Rs per month, while 19 (23.2%) were from middle class with income more than 400 Rs per month.

Figure 2. The incidence of J.E. varied in each month. 14 (17.1%) were admitted in the month of August, 15 (18.3%) were admitted in the month of September, 9 (11%) were admitted during the month of October, 23 (28%) were admitted in the month of November, 14 (17.1%) were admitted during the month of December. No patients were admitted during the months January to April. 2 (2.4%) were admitted in the month of May, none during the month of June and 5 (6.1%) were admitted in the month of July.

Fig 2. Association of Socio Economic Group and Cases

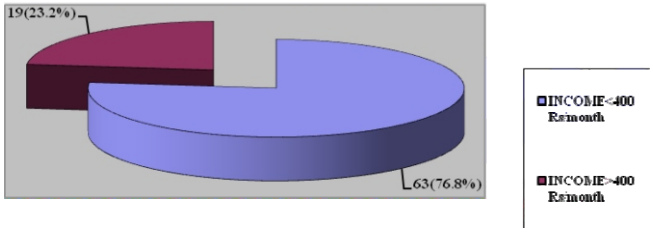


Table 2: Association Of J.E. Positive Cases And Flaviviral Infection With Place of Occurence:

Place of Occurence	Positive Cases And Fi	Negative	Total No of Cases	% of Positive Cases
Rural	25	40	65	38.46
Urban	6	11	17	35.29
Total	31	51	82	23.17

Fig 3. Monthly Distribution of Cases

The above table shows that more number of J.E. cases and flaviviral infections occur in the rainy season followed by in the winter season. During the epidemics acute encephalitic features that occurred correlated very well with J.E. The symptoms included fever in 80 (97.6%) of the cases, 22(26.9%) with high grade fever and 58 (70.7%) with moderate fever, headache in 53 (64.6%), vomiting in 37 (45.1%), altered sensorium in 66 (80.5%), convulsions in 57(69.5%), weakness in 18 (22%) and aphasia in 6 (7.3%) of the cases.

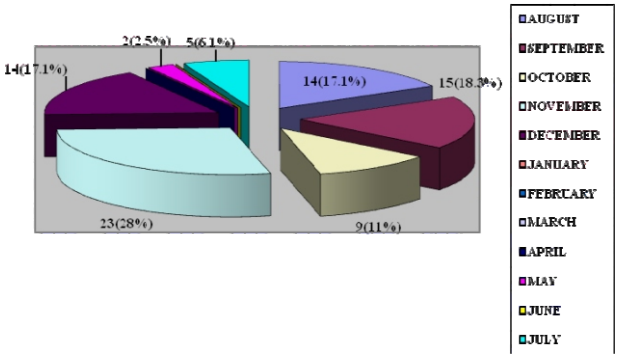
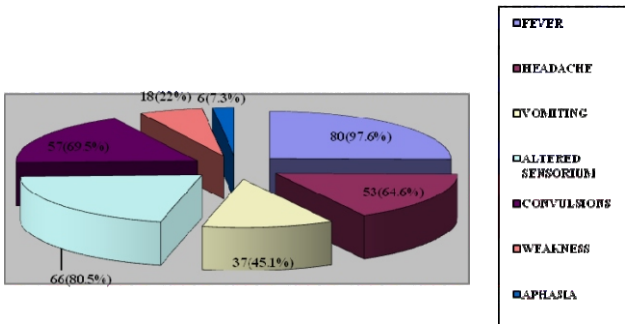


Table 3: Seasonal Distribution Of J.E.positive Cases And Flaviviral Infection

Place of Occurence	Cases	J.E.positive Cases	%	Flaviviral Infection	%
Winter (Nov-feb)	37	9	24.32	3	8.1
Summer (Mar-jun)	2	0	0	0	
Rainy (july-oct)	43	10	23.25	9	20.93
Total	82	19	23.17	12	14.63

Fig 4. Symptoms in Cases



4.Discussion

Encephalitis is an inflammation of the brain, which is a reaction of the body's immune system to infection or invasion. Arthropod borne viral encephalitis is responsible for most of the epidemic viral encephalitis. The viruses live in animal hosts and mosquitoes that transmit the disease. The viruses responsible for these diseases are classified as arboviruses and these diseases are collectively called as arboviral encephalitis. JEV encephalitis is the most common form of epidemic and sporadic encephalitis in the tropical region of Asia. Basically, J.E. is a zoonotic disease maintaining JEV in nature by bird-mosquito- bird and pig- mosquito- pig cycles. Pigs are the known amplifiers of JEV. Bats can also carry the virus for longer periods of time. Human beings are the only incidental hosts, forming a dead end [11]. In this study the role of epidemiological features involved in J.E. is well documented. Out of 82 patients studied, 65 (79.3%) were from rural areas and 17 (20.7%) were from urban areas.

Rachel Reuben and A Gajanana have stated in their study that J.E is predominantly a rural disease and occurs scattered over extensive areas. In his study in Andhra Pradesh 91% came from rural areas, 9% from urban areas in 1981 and in 1982, 68% came from rural areas and 32% from urban areas.6 Our study correlates very well Rachel Reuben's study. In a study conducted by Subash Chakraborthy et al cases were chiefly of rural origin [12]. In our study, out of 82 patients studied all had history of (H/O) having X contact with domestic animals (pigs, cattle or birds- chicken) which are reservoir hosts for J.E. 48 (58.6%) had H/O contact with pigs, 23 (28%) had H/O contact with cattle and 11(13.4%) had H/O contact with chicken. Vijay Rani and Gajanana have stated that pigs are the main amplifying hosts for JEV and the principal source of infection to vector mosquitoes, whereas cattles are dead end hosts. Therefore, their relative availability to J.E. vectors, which are principally zoophagic, is an important factor in JEV transmission. A high cattle to pig ratio in Thanjavur village in their study accounted for the low J.E. infection rate in children. This suggested a zoo prophylactic role played by cattle [13]. AK Chatterjee and K Banerjee, in their study found that in West Bengal the blocks which had more pigs than other areas reported more number of cases [14]. Benakappa et al have reported in their study that except for 2 cases, all other cases were seen in the Hindu community, probably reflecting the pig rearing habit of Hindus [15]. In our study out of the 82 patients studied, 68 (82.9%) children gave H/O staying in unhygienic areas like paddy fields which act as breeding places for mosquitoes while, 14 (17.1%) children did not have such history. T R Loach et al have stated in their study in Bihar that birds possibly maintained the virus which spilled over to ducks and pigs through the mosquitoes. Ducks and pigs are reared, often together and by the same owner. Open drains, kitchen garden and rich vegetation around house with open windows without nets and adequate moisture were all favourable for the mosquito borne transmission in their study. Low socio economic status and educational status of the people keeping pigs and ducks favoured the spread of the disease. The victims were occupationally drawn close to the natural focus of infection [16]. Out of 82 patients studied, 66 (80.5%) had no H/O taking mosquito prophylaxis, while 16 (19.5%) gave H/O taking mosquito prophylaxis either in the form of coils or repellents. 15 (18.3%) gave H/O using coils while 1 (1.2%) gave H/O using repellents. Dhanda et al have opined that Cx tritaeniorhynchus was the most abundant species encountered at their study site in Kerala from which most of the isolates were recovered. This was probably the main vector during the outbreak [17]. Kalyan Banerjee and Pradip K Desai have opined that in Tamil Nadu state, the vector of J.E., Cx tritaeniorhynchus rice field breeding mosquito is present in large numbers and accordingly it was expected that a higher number of J.E. seropositives would be in the villages. As the difference between towns and villages with the J.E positive sera is not significant, one is tempted to speculate the existence of other factors for such a state [18]. Out of 82 patients studied, 63 (76.8%) were from low socio economic group with income less than 400 Rs per month, while 19 (23.2%) were from middle class with income more than 400 Rs per month.

Kumar et al have found that J.E. was seen mostly in low socio economic group. Illiteracy, low socioeconomic status and unhygienic conditions contribute to the high incidence of J.E [19].

Benakappa et al have observed in their study that that the J.E. cases were usually drawn from rural low socio economic farmer families who lived close to the fields, in floor sanitary environment. However, nearly equal number of cases was seen from the city suburban slums which are virtually the rural island within the city [15]. Rachel Reuben and A Gajanana have opined that J.E is mainly a disease of the lower socio economic rural community where children help in farming operations [6]. The incidence of J.E. varied in each month in our study. 14 (17.1%) were admitted in the month of August, 15 (18.3%) were admitted in the month of September, 9 (11%) were admitted during the month of October, 23 (28%) were admitted in the month of November, 14 (17.1%) were admitted during the month of December. No patients were admitted during the months January to April. 2 (2.4%) were admitted in the month of May, none during the month of June and 5 (6.1%) were admitted in the month of July. Benakappa et al have observed peak incidence of J.E. during October to January in South India. Epidemics in Karnataka have a recurring nature seen once in 2 years. This suggests that epidemics occur as the herd immunity declines.15 S.K. Chakravarthy et al have opined that the seasonal prevalence of the disease depends on prevalence of the vector mosquitoes and other factors. In apparent infection of a large number of people (about 500 to 1000 per clinical case) plays a great role in the containment of the epidemic [20]. Rachel Reuben and A Gajanana have stated that the seasonal incidence of J.E.varies in different parts of India. J.E. may be suspected in any large outbreaks, particularly those occurring during the monsoon and post monsoon months. As the vectors (mosquito) of J.E. breed in rice field water, mosquito density begins to rise with extensive paddy planting at the start of the rainy season in July and August. This corresponds with breeding season of Ardeid birds in certain localised pockets. Virus transmission in pigs begins, and reaches its peak in September. Large numbers of infected mosquitoes have been detected at this time. The peak in human cases follows in October and November [6]. S R Prasad et al have opined in their study that in Southern India, cases of J.E. reported previously occurred mainly during the latter half of the year coinciding with the rainy season and the period of high mosquito prevalence [21]. During the epidemics acute encephalitic features that occurred correlated very well with J.E. The symptoms included fever in 80 (97.6%) of the cases, 22(26.9%) with high grade fever and 58 (70.7%) with moderate fever, headache in 53 (64.6%), vomiting in 37 (45.1%), altered sensorium in 66 (80.5%), convulsions in 57(69.5%), weakness in 18 (22%) and aphasia in 6 (7.3%) of the cases. Suraj Gupta has observed in his study fever in 96%, headache in 76%, nausea and vomiting in 52%, diarrhoea in 10%, altered consciousness in 78-100% and convulsions in 59.89%.22 Kumar Rashmi et al observed high incidence of fever in 94.5%, coma in 100%, convulsions in 84.7%, headache in 20.6% and vomiting in 54.3% cases [19].

5. Conclusion

J.E. is the most common form of sporadic and epidemic encephalitis in the tropical regions and should be ruled out first before considering the other viral causes. Rural population was found to be at a higher risk for contracting the infection. Pigs are the amplifier hosts and children with H/O contact with pigs had more chances of contracting the infection. Cattle and chicken can also act

as reservoir hosts. Illiteracy, low socio economic status and living in unhygienic conditions near rice fields contributed to the high incidence of J.E. in and around Bellary. Residents in endemic areas should take personal protection to reduce the number of mosquito bites, which include minimizing vector exposure at dusk and dawn, covering the body, using insect repellants and sleeping under nets. The peak incidence of J.E. is seen from October to December which is the post monsoon period in the area of study. However there can be variations between epidemics. The common clinical features observed were fever, altered sensorium, convulsions, headache, vomiting, weakness and aphasia. The serological results clearly establish the JEV etiology.

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