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AUTHORITY
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DEPARTMENT OF THE ARMY
Fort Detrick
Frederick, Maryland 21701
STUDY OF AN OUTBREAK OF VENEZUELAN ENCEPHALITIS IN

Venezuelan encephalitis has appeared in epidemic form in the Vene-
Zuelan portion of the Guajira, State of Zulia, since the week of May 1963 [5],
and has existed in epidemic form for a period not much greater, although,
there are suspicions that it has been confused with other viral diseases [1].
By 1962 the virus had been isolated from patients in a 1961-62 epidemic which
attacked the Guajira and extended to the eastern area of the country [2, 6].
In October 1963 the region experienced a new outbreak, which is analyzed in
the present article.

Description of the Epidemic

The affected region. The State of Zulia occupies the northern part of
Venezuela, between 71 and 73 degrees west longitude and 10° to 11° degrees north
latitude. The Paria District lies in the northwestern part of the state and
borders north and west on the Republic of Colombia, south on the District of
the same state, and east on the Gulf of Venezuela. The area is 3,140
square kilometers, and includes two municipalities—Paez and San Vicente. In
terms of vegetation three zones are distinguished: the tropical forest
zone, a pre-desert zone, and a desert zone. The two latter zones were the
ones most seriously affected by the epidemic; here the temperature is 25 de-
grees Centigrade in the shade with an annual rainfall less than 300 millimeters
(Figure 1). The population estimate for 1963 was 11,170, with an average density
of 8 inhabitants per square kilometer. In addition to the populated
centers there are numerous widely spaced ranches.

Development of the epidemic. The situation was seen to be abnormal when
a significant increase occurred in the number of cattle with an appearing at
the rural medical station in Paraguasipas, capital of the municipality of Gua-
Jira. An investigation performed around the village uncovered a large number

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of diseased horses and a certain number of dead horses. Experience in previous epidemics helped in forming a provisional diagnosis of Venezuelan encephalitis, which was later confirmed by isolation of the virus from the blood of several patients.

Isolation and identification of the virus. A suspension of whole brains from the acute phase of febrile patients, or from the brains of newborn Swiss white mice and in cultures of newborn Swiss white mice and in cultures of newborn Swiss white mice and in cell culture propagated to CPE (cell culture propagated to CPE). Fourteen viruses were isolated from 14 inoculated mouse brains, and of these, 13 were subsequently propagated in one or both of the mouse samples, using the following techniques: mouse protection. The problem sample was divided into two equal parts with serum which was immune to the virus of Venezuelan encephalitis (VEE) (immune horse serum, Lot 1, National Communicable Disease Center, Atlanta, Georgia); the other part was mixed with a phosphate buffer stock of pH 7.4. Both mixtures were incubated at 37 degrees Celcius for an hour and then inoculated intracerebrally into newborn Swiss white mice. The brains inoculated with the problem serum which had not been treated with serum died 20 hours after inoculation. The mice protected with immune serum were observed for one week and showed no signs of disease whatever.

Serological studies. Twenty pairs of serum, matched convalescent, were studied using Clarke and Casals hemagglutination inhibition test [6] modified by Sever as a microtechnique [7] and employing mouse brain homogenate or the non-specific inhibitors. In 18 cases there was a clear increase in titre of antibodies to the VEE virus (Table 1).

Criteria for classifying the evidence. Using the criteria employed in 1968 [1], four groups were considered. Group 1 included all those patients who showed three or more of the following symptoms: fever, headache, intense headaches, pharyngeal congestion, facial dryness, splinter nails, papilledema, concomitant manifestations of rash, rash, rash and other rash, rash and other rash. Group 2 was made up of patients with one of the foregoing symptoms plus one of the most serious manifestations of meningitis, meningitis, meningitis, or meningitis, meningitis, meningitis. Group 3 consisted of doubtful cases, very close, but not distinguishable from any other febrile condition. These patients were not included in the case studies. Group 4 contained all patients with any defined illnesses different from Venezuelan encephalitis.

Distribution throughout time. Figures 2 and 3 show the number of patients consulting the medical stations in Paraguay and the number of patients consulting the medical stations in Paraguay and the number of patients consulting the medical stations in Paraguay and the number of patients consulting the medical stations in Paraguay and the number of patients consulting the medical stations in Paraguay. The number of patients at the medical stations began to decline on the day control measures were begun. The epidemic curve for each municipality does not differ from the overall curve for the entire district (Figure 4).

Rate of attack. Table II shows the population of the Ruiz District estimated as of 1 July 1968 and the rate of attack of the disease per 1,000 inhabitants. The villages most seriously affected were Ruiz asipica, La Punta, Los Filudes, Hacienda, and El Cardo, located in a relatively small area shown

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in Fig. 5. A total of 1,077 symptomatic cases of Venezuelan encephalitis were registered. Of these, 150 showed involvement of the nervous system. Only two deaths were attributable to the disease in children under one year of age.

Table III shows the distribution of the disease in different age groups. The highest incidence of the disease is observed in the age group 6-10 years of age, a fact which can be seen more clearly in Table V. The mortality rates in population groups above and below 4 years of age are negligible, and the incidence is extremely significant. Among older people the incidence is progressively smaller. Table V shows the distribution of the disease in females. In the extreme age, below one year and above 50, there is a differentiation for females. The other age groups show no significant difference based on sex.

Discussion

The disease has been known in epidemic proportions in Venezuela since 1936 [4], although Callo and Vogelzang [5] already reported its occurrence in the area in 1930. Encephalitis among humans, however, was not diagnosed until 1957. The explanation given by Avila [1] for the absence of the disease in the region in 1910, 1915, 1916, 1920, 1925-27, 1931, and 1938 is that the outbreaks of Venezuelan encephalitis in 1910, 1914-15 and 1919 could have been similar to the influenza outbreaks in 1918. The outbreaks of 1931 and 1936 may have been due to outbreaks of Venezuelan encephalitis in 1930 and 1937, respectively, although the outbreaks of 1940 and 1959, the outbreaks diagnosed as influenza could also have been outbreaks of Venezuelan encephalitis when it is noted that there were also cases of meningitis and encephalitis in those years. It was not until 1962 that the presence of the virus of Venezuelan encephalitis was confirmed in patients during an epidemic which was widespread in the region [6].

The fact that the mortality rate is high among children under 6 years of age indicates that the virus has not been widely transmitted in the population since the epidemic of 1962. This agrees with the absence of antibodies against Venezuelan encephalitis among children under 5 years of age in the Guaviay 1947-1962. From the history of the disease in the area, it can be concluded that the period of a cyclic activity and that there are no cases of the disease in the absence of previous epidemics.

Some authors [3, 6] have reported the experimental passive disappearance of a certain type of antibodies in individuals who have suffered Venezuelan encephalitis. But the epidemiological evidence indicates that this apparent loss does not modify the acquired resistance to the disease. It is observed that mortality rates are progressively lower among older ages, and this, in a population uniformly exposed to the causative agent, is a demonstration of immunity. Furthermore, one can observe a recent infection in children under one year old, which can be explained as not being transmitted maternal antibodies. It can be concluded from the form that the disease confers long-lasting immunity.

In addition to the 1,077 cases examined clinically, there were around 500 consulting patients with febrile conditions which were not diagnosed as Venezuelan encephalitis because they did not meet the established criteria but

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who probably had very benign cases of the disease. It is also probable that 'subclinical' infections caused by this virus, since high titera of anti-Venezuelan equine encephalitis virus were found in zones where no epidemics of Venezuelan equine encephalitis have described, such as the region to the south of Lake Maracaibo. The prevalence of the disease must have been much greater than the clinical cases.

The serious neurological cases amounted to 3% of the total of patients, a high percentage in comparison to other encephalitis, from which the level was calculated at 6%. If we include among this group the consulting patients placed above in group 3, we arrive at a total of 9% of neurological cases, a number which is in any case higher than in previous epidemics. The number of deaths attributable to the disease was 0.1%, which is much lower than the figure for the previous epidemic [3].

No logical explanation was found for the marked discrepancy for females among children less than one year old and adults over 40. It should be noted that the difference was observed only in males.

Summary

A epidemic of Venezuelan encephalitis was reported in October 1968 in the District of Pueblo, State of Zulia, on the Venezuelan border. A total of 1,077 cases of the disease were registered, 950 of which had clinical evidence of attack on the nervous system. Two deaths were attributed to the encephalitis, both in children less than one year old. The ratio of the number of cases among children less than 6 years old, which forms the bulk of the last encephalitis epidemic in the region, which points to immunity conferred by the virus. It was concluded that the virus is inactive in short time periods. The immunity conferred by the virus is apparent after the age of 40, as indicated by the small number of older patients and the mortality in children than one year old, the latter protected by maternal immunity.


Figura N° 1. Mapa del Distrito Mara en el cual se indican las provincias y zonas afectadas por el h記.

Figura N° 2. Número de consultantes a la Redacción Rural de Paraguay desde el 1° de Octubre de 1966. Se observa la aparición del brote el 23 del mismo mes.

Figura N° 3. Número de consultantes de la Redacción Rural de Paraguay durante el último lapso de tiempo. Aunque se observan avances consistentes de los curvas de tierra y ganas, la curva en este período y de menor consistencia. (Bebidas y procesamiento de alimentos).

Figura N° 4. Curva epidémica para todos el Distrito y para cada Municipio. La epidemia se produjo principalmente en espacios del Municipio Guaicura. El Municipio Minasubán contribuyó poco a la formación de la curva. (Paraguayas, Minasubán, Mara, Distrito Mara).

Figura N° 5. Mapa del Distrito en el cual se indican las zonas afectadas. En la zona en negrita se registraron casi 500 casos. Los casos ubicados en la zona gris aparecieron entre 500 y 600 casos. El resto de los 1.077 casos se mantuvieron en el área considerada.
Figure 1. Map of the District of Puebla, showing villages and settlements affected by the outbreak.

Figure 2. Number of consultants at the medical station of Puebla beginning on 1 October 1963. The outbreak at the outbreak on 27 October is visible.

Figure 3. Number of consultants at the medical station of Sina. The number of febrile and convulsive cases can be seen, the number irregular and lower. (Febrile: ----, neurological ----, total: ---)

Figure 4. Epidemic curve for the counties of both municipalities. The epidemic affected principally the county of El Jire. The municipality of Sina contributed 7 cases to the curve. (Puebla ----, Sina: ----, Puebla: ----)

Figure 5. Map of the District, showing the vicinity affected regions. The region in black registered more than 200 cases. The villages in the grey region reported between 200 and 500 cases. More than 1,077 cases were found in the checked region.

Spanish Words Used in Figures

total total
febrile febrile
neurológico neurological
consultantes consultants
Octubre October
Noviembre November
casos cases
Tipos I y III Types I and III
### TABLA I

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### TABLA II

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Para el 1º de julio de 1968.

### TABLA III

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Venezuelan equine encephalitis, Paez District, State of Zulia, 1968.
Numbers of cases by municipalities and rate of attack per 1,000 inhabitants
As of 1 July 1968

Table III

1. Distribution of cases by age groups. Rate of attack per 1,000 inhabitants
2. Age groups
3. Guajira Municipality
4. Sinamaica Municipality
5. Paez District
6. Cases
7. Estimated population
8. Rate
9. Up to one year old
10. One to 6 years old
11. Forty and older
12. Age unknown
13. Total

Table IV

1. Differences in mortality rates between those above and below 6 years of age
2. Age groups
3. Guajira Municipality
4. Sinamaica Municipality
5. Paez District
6. Cases
7. Estimated population
8. Rate
9. Less than 6 years old
10. Over 6 years old
Table V

1. Distribution of cases by age groups and estimated number of attack per 1,000 inhabitants
2. Age groups
3. Guajira Municipality
4. Sinímaca Municipality
5. 'Oso District
6. Cases
7. Estimated population
8. Rate
9. Up to one year old
10. One to 6 years old
11. Forty and older
12. Age unknown
13. Total
   V Male
   M Female

C50: T-798-W