SURVIVAL OF THE ENTEROPATHOGENS IN THE VARIOUS SOURCES OF WATER IN CHIENGMAI

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ABSTRACT

At the time of the cholera outbreak in Chiengmai in 1963-1964 some water from jars in homes yielded cholera vibrios. It would be helpful to know the longevity of the enteropathogens in such water jars. This experiment were conducted by using the water from various sources in Chiengmai. The initial bacterial population, pH, calcium and iron determination of the water from each source at the time of collection were studied, and the water was kept in "Shanghai jars" (unglazed earthen vessels). Each water jar was contaminated in triplicate with Vibrio cholerae El Tor-Ogawa, Salmonella typhosa and Shigella flexneri III to a final concentration of 10^4 of each organism per milliliter in 100 liters of water in the jar. The viability was detected by the millipore filter-enrichment technic. The results obtained indicated that shigellae and salmonellae lived for only a few days, but only cholera vibrios survived up to ten days in the water from both deep and shallow wells and seven days in rain diluted water. The effective concentration of inoculum was between 10^4 to 10^5 of each organism per milliliter of water. This work contributes an understanding of the epidemiology of enteric infection in Chiengmai.

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INTRODUCTION

It is well known that there are many ways of transmitting organisms causing diarrheal diseases. In much of the literature water, food, flies and carriers have been incriminated as the important vehicles of transmission (6, 8, 12, 14, 19, 20, 25, 26, 27, 30, 32, 35, 36, 39, 49, 53), but water has been considered the chief role in the spread and persistence of enteric infection (1, 2, 3, 4, 5, 10, 23, 29, 33, 34, 37, 41, 43, 44, 46, 47).

The role of contaminated water in the spread of cholera has been long established by John Snow in 1854 with his study of polluted water obtained from the Broad Street pump (47). More than five hundred people consuming this water were killed by cholera within ten days. The opening of the Culcutta water-works in 1870 dropped the incidence of cholera infection by two thirds (29). For cholera endemicity in India and Pakistan in 1901-1945, South-west Bengal in 1934-1948, and Burma in 1918-1938, it has been concluded in statistical reports that more villages situated on the banks of water sources were affected by the cholera vibrio than villages far away from them (51). The investigation of Abou-Gareeb showed the continuous potential contamination of the Hooghly River and its tributaries by Vibrio cholerae during epidemic and non-epidemic periods in the year 1958-1959 (2). Polluted water is a major vehicle of contamination in the preparation of food and washing of eating utensils. This fate was confirmed by Forbes and Teng (22) in their investigations of the outbreak of cholera in Kowloon in 1964, this outbreak was caused by the contaminated tank and well of a restau-

rant on Temple Strect. Suksuvan showed that the contamination of fruit and vegetables could be accomplished by a common practice of the merchants of freshening the produce with water from nearby rivers, klongs or wells (50). The recent report of Drachman and his colleagues (17) on an outbreak of Shigella gastroenteritis in Utah in July, 1956 presented evidence which incriminated the public water supply as the vehicle of infection. The increase of typhoid fever in Klafeld-Geiweid during 1946 and 1947 due to the pollution of drinking water was reported by Wuestenberg and his co-workers (55). Achnovich and his colleagues (3) reported that the outbreak of typhoid fever in Russia in the winter of 1957-1958 was of a water-borne nature.

Recent studies in Bangkok, Thailand, in 1959-1960 pointed out that water from rivers, klongs, and stagnant ponds was contaminated by Vibrio cholerae, Shigella and Salmonella (34, 46). The same results were obtained by Le Beau during his investigations in Chiengmai from December, 1963 to March, 1965 (33).

Since the Mae Ping River is the major source of water in Chiengmai, the level and degree of dilution by the rain are varied every month. It is suspected that the survival rate would change due to the degree of dilution. The change of viability of cholera vibrio in water due to the competition with other organisms and depletion in nutrient material has been discussed by Khan (28). Ahmed found that in boiled or filtered water the organisms multiplied with a rise in titer for two or three days, after which the counts dropped consistently to elimination (5). Mukerjee, and his

colleagues indicated that none of the environmental factors including temperature, humidity, rain-fall and pH showed any direct relationship with viability of Vibrio cholerae. But the most important factor influencing viability was probably the available nutrition for the vibrios present in the water (37). From the investigation of Bunnag (7) cholera vibrio can live longer in rain water collected in opened air than water from a well. This report is in conflict with the others, because such rain water should not contain much food. Since the epidemic of cholera in Chiengmai in 1963 to 1964 was associated with the high dilution of Mae Ping River by rain, an investigation of the effect of rain dilution on enteropathogen survival may give an explanation for increased viability and even seasonal endemicity.

The surveillance of storage jar water by Ahmed (5) indicated that there is occasionally transmission of cholera vibrios from an individual to the water. Orth has shown the water from rivers and klongs as well as family water jars yielded cholera vibrios (41). Morgan and his colleagues showed that pollution of water in a jar took place when contaminated hands dipped the handleless bowl or pan into the water while obtaining a drink or drawing water for washing purposes (34, 35).

The early stages of the epidemic of cholera in Chiengmai in 1963 to 1964 was associated with areas flooded by Mae Nam Ping. In the later stages of the epidemic cases were increasingly found in areas not flooded. In two such instances water from jars in the home yield vibrios (33).

This emphasizes a need to understand the role of water jar in the endemiology and epidemiology of enteric infection in Chiengmai. Investigation of the home sanitary facilities, along with the water customs within the home, help us to understand how the water jars can become contaminated (and this will be discussed later), however, we have no indication of the survival rate of enteric pathogens in the water of Chiengmai. The viability of typhoid bacilli in distilled water has been observed by Shrewbery and Barson (45). The survival of dysentery bacteria in natural water of Moscow, USSR, was determined by Talayeva (52). The information of the survival of Shigella, Salmonella and Vibrio cholerae in sea water has been reported (7, 13, 38). The work on survival of Vibrio cholerae in water from India (31, 37, 40), Philippines (42) and even in Bangkok, Thailand (7, 35) has been published. But the role of the water jar in the survival of the enteropathogens has not been studied. This observation would have the practical value for planning epidemiological control measures. Since the climatic and geological conditions of Chiengmai vary so greatly from that of Bangkok and other places in Thailand, there is need for carefully collected data from the north.