Effect of Climate Changes on the Epidemics of Arthropod-Borne Viral Diseases (Abstract of the final Report)

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1. Introduction

There are more than 50 species of arthropod-borne viruses (arboviruses) that cause diseases in humans. Some of these viral infections have high mortality rate and are a serious health problem in many areas of the world. Vaccines are available only for limited numbers of viruses. The number of the patients with various arbovirus infections has been increasing and the epidemic areas have been expanding. One of the main factors is considered to be the number of the vectors, e.g. mosquitoes. In order to understand the features of arbovirus infections, it is necessary to elucidate the effect of climate changes, especially temperature and rainlfall, on the epidemic situations of these arboviral diseases. Reliable diagnostic methods to accurately estimate the number of patients are also needed for the analyses. Furthermore, development of new vaccines, new prevention measures and treatments are important subjects of the research for comprehensive preventive measures.

2. Research Objectives

1) *Aedes albopictus* is the mosquito that has an ability to transmit dengue viruses and other arboviruses. *Aedes albopictus* exists in Japan; however, the distribution and the changes in the distributing areas have not been well understood. The distribution of *Aedes albopictus* in the Tohoku district was studied. Furthermore, the number of the generation of mosquitoes was evaluated in each city.

2) The susceptibility of Culex inatomii to West Nile virus was evaluated.

3) Pig plays an important role as the amplifier in maintaining Japanese encephalitis virus in nature. The percentage of pigs seroconverted to Japanese encephalitis virus was evaluated in comparison with various climate factors.

3. Research Methods

1) Cities were selected in the Tohoku District and the presence of *Aedes albopictus* was examined in these cities. The cities included those which had an average annual temperature equal to or higher than 11 degree C, but where *Aedes albopictus* have not been reported and those which had average annual temperature lower than 11 degree C, but where *Aedes albopictus* have not been reported.

2) Mosquitoes, Culex inatomii, were infected West Nile virus. West Nile virus genome was examined by RT-PCR in various parts of the body.

3) Seroconvertion rates of pigs to Japanese encephalitis virus were obtained from 1982 to 2003. The seroconvertion rate was analyzed based on various climate factors including average temperature and the levels of rainfall.

4. Results

1) *Aedes albopictus* was detected in Noshiro city where *aedes albopictus* was first detected in 2001. The distribution of *aedes albopictus* has been expanding in Tohoku district.

2) The generation numbers of *aedes albopictus* was 4.0 in the cities where the mosquitoes were constantly detected, while it was 2.8-3.6 in those where the mosquitoes were inconstantly detected.

3) If the average temperature increases by 2 degree C, it is likely that *aedes albopictus* will inhabit in most of the plains in Tohoku district.

4) Culex inatomii were susceptible to West Nile virus. Virus genome was detected in abdomen, thorax, legs and head 10days after the mosquitoes sucked blood mixed with West Nile virus.

5) Seroconvertion rates to Japanese encephalitis virus among sentinel pigs were related to high temperature in the summer season. On the other hand, it was inversely related to the levels of rainfall.

Discussion

The studies clearly demonstrated that the northern boundary of the *Aedes albopictus*-detected area has been shifting to the north. The factors which contributed to the expansion of the *Aedes albopictus*-detected area include temperature and population over certain levels. Culex inatomii was sensitive to West nile virus as well as Cx. p. pallens、Cx. p. molestus、and Aedes albopictus. High temperature has a positive effect on the seroconvertion rate of pigs to Japanese encephalitis virus, while the levels of rainfalls have an inverse effect. The studies demonstrated that the climate has various effects on activity of Japanese encephalitis virus in nature, probably also on other mosquitoe-borne viruses.