Adaptive immunity and antibody-dependent enhancement in dengue secondary infection

Sourav Kumar Sasmal\textsuperscript{1} Yasuhiro Takeuchi\textsuperscript{2} Shinji Nakaoka\textsuperscript{3}

\textsuperscript{1}Department of Physics and Mathematics, Aoyama Gakuin University, Kanagawa 252-5258, Japan
sourav.sasmal@gmail.com, sourav.sasmal@gem.aoyama.ac.jp

\textsuperscript{2}Department of Physics and Mathematics, Aoyama Gakuin University, Kanagawa 252-5258, Japan
takeuchi@gem.aoyama.ac.jp

\textsuperscript{3}Faculty of Advanced Life Science, Hokkaido University, Sapporo, Hokkaido, 060-0810, Japan; PRESTO, Japan Science and Technology Agency, Saitama, 332-0012, Japan
shinzy.nakaoka@gmail.com

Dengue is the most common mosquito-borne viral disease and causes a significant number of deaths, mostly in the tropical and subtropical regions. It is caused by the four distinct but antigenically related viruses, known as serotypes, which are transmitted to humans through Aedes mosquito. Currently, more than half of the World’s population lives in the area where the Aedes mosquito present. Due to climate changing, dengue incidence is increasing day by day, and more countries are reporting their first outbreak. The desire to establish the factors determining the disease severity and the growing need for efficient drugs has prompted extensive research interest in within-host viral dynamics. However, very few mathematical models of within-host dengue dynamics pertaining to secondary dengue infection are presently available. To address this gap in the pertinent literature, in this work, a secondary dengue infection model with T-cell mediated adaptive immunity and antibody-dependent enhancement was developed by considering the memory cell and heterogeneous antibody as the main factor. In case of secondary dengue infection, both the virus and homogeneous antibody production are enhanced due to the influence of memory cells remaining from the previous dengue infection. Owing to the high model sensitivity, it was possible to establish that, among antibody-dependent enhancement mechanisms, the increased virus replication inside the infected cell, which increases the overall virus burst size, exerts the maximum effect on disease severity during secondary infection. The obtained results concur with the clinical observations and may be helpful in further research.

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on antibody-dependent enhancements aimed at producing schemes relevant for the
dengue vaccine design and development.

References

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