A review of immune amplification via ligand clustering by self-assembled liquid-crystalline DNA complexes

Ernest Y. Lee, Calvin K. Lee, Nathan W. Schmidt, Fan Jin, Roberto Lande, Tine Curk, Daan Frenkel, Jure Dobnikar, Michel Gilliet, Gerard C.L. Wong

PII: S0001-8686(16)30047-1
DOI: doi: 10.1016/j.cis.2016.02.003
Reference: CIS 1625

To appear in: *Advances in Colloid and Interface Science*

Received date: 18 October 2015
Revised date: 9 February 2016
Accepted date: 10 February 2016

Please cite this article as: Lee Ernest Y., Lee Calvin K., Schmidt Nathan W., Jin Fan, Lande Roberto, Curk Tine, Frenkel Daan, Dobnikar Jure, Gilliet Michel, Wong Gerard C.L., A review of immune amplification via ligand clustering by self-assembled liquid-crystalline DNA complexes, *Advances in Colloid and Interface Science* (2016), doi: 10.1016/j.cis.2016.02.003

A review of immune amplification via ligand clustering by self-assembled liquid-crystalline DNA complexes

Ernest Y. Lee[a], Calvin K. Lee[a], Nathan W. Schmidt[b], Fan Jin[c], Roberto Lande[d,e], Tine Curk[f], Daan Frenkel[f], Jure Dobnikar[f,g,h], Michel Gilliet[d], and Gerard C.L. Wong[a,*]

[a]Department of Bioengineering, University of California, Los Angeles, California 90095, United States
[b]Department of Pharmaceutical Chemistry, University of California, San Francisco, California 94143, United States
[c]Hefei National Laboratory for Physical Sciences at Microscale, Department of Polymer Science and Engineering, CAS Key Laboratory of Soft Matter Chemistry, University of Science and Technology of China, Hefei, P. R. China 230026
[d]Department of Dermatology, Lausanne University Hospital CHUV, 1009 Lausanne, Switzerland
[e]Department of Infectious, Parasitic and Immunomediated Diseases, Istituto Superiore di Sanità, Rome, Italy
[f]Department of Chemistry, University of Cambridge, Lensfield Road CB21EW, Cambridge, UK
[g]Department for Theoretical Physics, Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia
[h]International Center for Soft Matter Research, Beijing University of Chemical Technology, Beijing, P. R. China 100029

[*]Corresponding author

Abstract

We examine how the interferon production of plasmacytoid dendritic cells is amplified by the self-assembly of liquid-crystalline antimicrobial peptide / DNA complexes. These specialized dendritic cells are important for host defense because they quickly release large quantities of type I interferons in response to infection. However, their aberrant activation is also correlated with autoimmune diseases such as psoriasis and lupus. In this review, we will describe how polyelectrolyte self-assembly and the statistical mechanics of multivalent interactions contribute to this process. In a more general compass, we provide an interesting conceptual corrective to the common notion in molecular biology of a dichotomy between specific interactions and non-specific interactions, and show examples where one can construct exquisitely specific interactions using non-specific interactions.

Keywords: Innate immunity, TLR9, dendritic cells, interferon, liquid crystals, polyelectrolytes, like-charge attraction, statistical mechanics, multivalency, counterions, SAXS