T cell motility within lymph nodes are more consistent with a correlated random walk than a Levy walk

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***Short Abstract* — Naïve T cells search within lymph nodes for antigen to initiate the adaptive immune response. T cell search can be characterized as a random walk, and recent evidence shows that T cells can move in a Levy-type motility in brain. We demonstrate that T cells in lymph nodes can move with some features of a Levy-signature. But T cell motility is best described by a correlated random walk.**

***Keywords* — T cell motility; T cell search; lymph nodes.**

I. Purpose

Naïve T cell motility within lymph nodes (LNs) is crucial for the initiation of the T cell response [1]. Multiphoton imaging has allowed direct visualization of T cell movement in LNs, demonstrating T cell search as a random walk [2]. Different types of random walks exist in biological systems, including Brownian and Levy walks [3]. Levy walks differ from Brownian walks by the presence of large steps, and naïve T cell motility in LNs had been assumed to be a Brownian walk [4]. Recent evidence suggests that the motility of T cells in the brain is characterized by a Levy signature, not a Brownian walk [5]. However, detailed analysis naïve T cells search within LNs has not been done.

II. Conclusions

Here we present evidence that motility of naïve T cells in LNs show some features of a Levy walk. Using multiphoton microscopy, we determined displacement and step size taken by naive T cells in LNs. We find that naïve T cell motility show a heavy-tailed distribution characteristic of a Levy signature. However, we do not observe a classical Levy walk as defined by a power-law fit. Instead, the best fit for T cell motility is a log-normal distribution. We find that T cell motility is best fit by a correlated random walk. We then use computer modeling to assess the efficiency of T cell search parameters. We find that heavy-tailed distributions are as efficient as the classical Levy walk at target search. These findings shed new light on the fundamental mechanisms driving T cell search for antigen within lymph nodes.

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