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Mechanosensing in the immune response

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Abstract

Cells have a remarkable ability to sense and respond to the mechanical properties of their environment. Mechanosensing is essential for many phenomena from cell movements and tissue rearrangements to cell differentiation and the immune response. Cells of the immune system get activated when membrane receptors bind to cognate antigen on the surface of antigen presenting cells. Both T and B lymphocyte signaling has been shown to be responsive to physical forces and mechanical cues. Cytoskeletal forces exerted by cells likely mediate this mechanical modulation. Here we discuss recent advances in the field of immune cell mechanobiology at the molecular and cellular scale.

Keywords: immune cells; mechanosensing; cytoskeleton; forces; T cell receptor; actin

1. Introduction

The mechanical environment of cells, such as the extracellular matrix (ECM) or other cells, plays a critical role in regulating many aspects of cell function [1, 2]. Examples of mechanical stimuli include forces due to muscle contraction, shear stresses induced by flow in blood vessels or strains induced by collective movements of tissues. Similarly, cells also encounter environments with varying physical properties, such as tissue or stiffness of the ECM, topography and fluidity. Studies have revealed that in addition to soluble chemical cues, the physical environment plays a key role in controlling cell proliferation, cell fate determination, cell migration and global organization of tissues by regulating genetic and biochemical signaling pathways [1]. Mechanical regulation of cell function appears to result from a conserved set of physical mechanisms [3]. Forces arising from the actin cytoskeleton and myosin