Title
Nuclear Actin Dynamics Regulate Nuclear Organization and Transcription

Journal
Biophysical Journal, 108(2)

ISSN
0006-3495

Authors
Serebryannyy, Leo
Parilla, Megan
Annibale, Paolo
et al.

Publication Date
2015

DOI
10.1016/j.bpj.2014.11.2941

2716-Pos Board B146

Nuclear Actin Dynamics Regulate Nuclear Organization and Transcription

Leo Serebryannyy[1], Megan Parilla[1], Paolo Annibale[2], Christina Cruz[1], Dmitri Kudryashov[3], Enrico Gratton[2], Cara J. Gottardi[4], Primal de Lanerolle[1].
[1]Physiology and Biophysics, University of Illinois at Chicago, Chicago, IL, USA, [2]Laboratory of Fluorescence Dynamics, University of California at Irvine, Irvine, CA, USA, [3]Chemistry and Biochemistry, Ohio State University, Columbus, OH, USA, [4]Medicine, Northwestern University, Chicago, IL, USA.

Actin is an important and elegant mechanotransducer that transfers messages from the extracellular environment into the nucleus, thus conferring changes in both the physical properties and the genetic program of the cell. Although actin in the nucleus has been established in a growing number of functions, the form of nuclear actin remains poorly understood as there are no apparent actin filaments in the nucleus. Therefore, we tested how disrupting the form of nuclear actin impacts function and what effects this may have on the nucleus. To do so, we formed stable nuclear actin filaments using a variety of methods, including the nuclear enrichment of actin binding proteins supervillin and α-E-catenin and the expression of a mutant form of skeletal α-actin. Using fluorescence recovery after photobleaching (FRAP), we found that stabilization of nuclear actin filaments significantly impairs actin dynamics within the nucleus. The formation of nuclear actin filaments coincides with striking changes in nuclear structure and overall nuclear topography as determined by confocal microscopy and raster image correlation spectroscopy. Using a combination of FRAP analysis, structured illumination microscopy and immunological assays, we found that nuclear actin filaments reduce the association of actin with RNA polymerase II and this correlates with impaired RNA polymerase II dynamics, localization and gene recruitment. Moreover, we were able to recapitulate our findings in purified nuclear extract by using in vitro transcription assays with the covalent actin crosslinking domain (ACD) of V. cholerae MARTX toxin. Based on our data, which help explain the absence of nuclear actin filaments in the interphase mammalian nucleus, we propose a model where nuclear actin dynamics are critical for maintaining proper nuclear function.