Tata Institute of Fundamental Research
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Seminar

Role of microtubules and associated proteins in mitochondrial dynamics and partitioning

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Mitochondria are organized as tubular networks in the cell and undergo fission and fusion. Although several of the molecular players involved in mediating mitochondrial dynamics have been identified, the precise cellular cues that initiate mitochondrial fission or fusion remain largely unknown. In fission yeast (Schizosaccharomyces pombe), mitochondria are organized along microtubule bundles. Here, we employed deletions of kinesin-like proteins to perturb microtubule dynamics and used high-resolution and time-lapse fluorescence microscopy, revealing that mitochondrial lengths mimic microtubule lengths. Further, we determined that compared to wild-type cells, mutant cells with long microtubules exhibit fewer mitochondria, and mutant cells with short microtubules have an increased number of mitochondria, because of reduced mitochondrial fission in the former and elevated fission in the latter. Correspondingly, upon onset of closed mitosis in fission yeast, wherein interphase microtubules assemble to form the spindle within the nucleus, we observed increased mitochondrial fission. We found that the consequent rise in the mitochondrial copy number is necessary to reduce partitioning errors during independent segregation of mitochondria between daughter cells. We also discovered that the association of mitochondria with microtubules physically impedes the assembly of the fission protein Dnm1 around mitochondria, resulting in inhibition of mitochondrial fission. Taken together, we demonstrate a mechanism for the regulation of mitochondrial fission that is dictated by the interaction between mitochondria and the microtubule cytoskeleton. Finally, we show that cortical tethering of mitochondria by the dynein anchor Mcp5 enables uniparental mitochondrial inheritance during meiosis in fission yeast.

Monday, Jun 10th 2019

4:00 PM (Tea/Coffee at 3:30 PM)

Seminar Hall, TIFR-H