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PARASITE BIOLOGY

Dual-core centrosomes power cell division

Apicomplexan parasites, such as the human pathogen *Toxoplasma gondii*, are obligate intracellular pathogens that undergo a complex developmental process that involves genome replication, cell division and the assembly of new invasive forms. A striking feature of apicomplexan development is the unique two-stage cell cycle, in which multiple rounds of genome amplification occur without cytokinesis, followed by a single round of genome replication and subsequent daughter-cell budding. The mechanistic basis of this has been unclear but Suvorova *et al.* now report that in *T. gondii*, the centrosome (a eukaroyotic organelle that regulates the cell cycle) is divided into spatially and compositionally distinct inner and outer cores that together coordinate replication and cytokinesis.

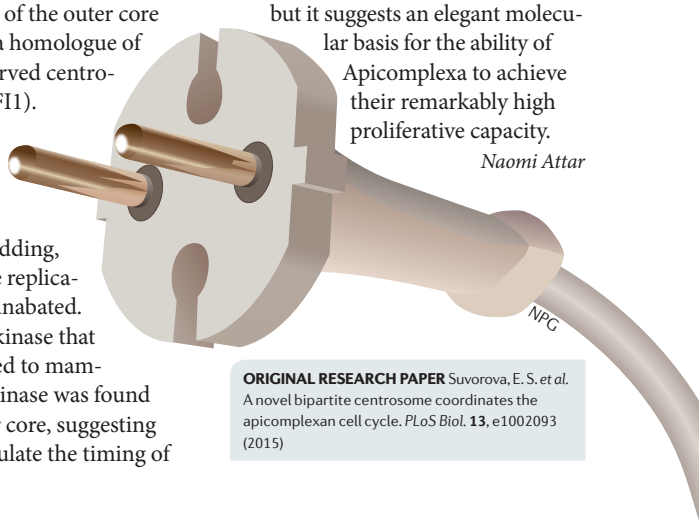
To determine the *T. gondii* proteins that are involved in coordinating the functions of the centrosome, the authors mined Apicomplexa genome sequences for conserved centrosomal proteins. One protein identified by the authors was TgCEP250, the *T. gondii* homologue of the CEP250 centrosomal protein. Surprisingly, TgCEP250 was found to form two distinct foci within each centrosome, and colocalization analysis of other centrosomal proteins showed that these two foci represented spatially segregated inner and outer cores, each with a distinct protein composition. The authors hypothesized that the spatial segregation of the two cores reflected separate functions during the cell cycle. The association of the inner core with the nuclear envelope suggested a role for this structure in regulating genome replication, whereas the proximity of the outer core to the site of daughter-cell assembly suggested a role in cytokinesis.

To test this hypothesis, the authors obtained a temperature-sensitive mutant of the outer core protein TgSfi1 (a homologue of the highly conserved centrosomal protein SFI1). Loss-of-function of TgSfi1 resulted in a block in daughter-cell budding, whereas genome replication continued unabated. Furthermore, a kinase that is distantly related to mammalian Aurora kinase was found only in the outer core, suggesting that it might regulate the timing of daughter bud assembly. The authors also identified TgMAPK-like 1 (TgMAPK-L1), a kinase related to the mammalian MAPK family of serine/threonine protein kinases, which are not usually found in the centrosome. TgMAPK-L1, which was localized to a pericentrosomal structure surrounding both cores, limited replication of both cores to once per cycle and was essential for new daughter parasites to inherit one copy of each core. Microscopy data showed that inner core proteins are synchronized with the centrocone (an apicomplexan structure that is tethered to chromatin) during the cell cycle, which is consistent with a role in genome replication.

Together, these data establish that apicomplexan centrosomes have an unusual bipartite structure that is specialized for independently coordinating daughter-cell budding and genome replication. This model requires experimental confirmation but it suggests an elegant molecular basis for the ability of Apicomplexa to achieve their remarkably high proliferative capacity.

Naomi Attar

> “apicomplexan centrosomes have an unusual bipartite structure”



ORIGINAL RESEARCH PAPER Suvorova, E. S. *et al.* A novel bipartite centrosome coordinates the apicomplexan cell cycle. *PLoS Biol.* **13**, e1002093 (2015)