Proposal of Master Research Project / Trabajo fin de Master for the academic year 2022-23

Group name: **Neurogenesis and cortical expansion**
IP name: **Víctor Borrell**
Group web: **https://vborrelllab.wixsite.com/website**

Title of the MRP/TFM:
Analysis of mitochondria dynamics in cortical progenitor cells.

Summary of the Project:
The human cerebral cortex is among the largest in mammals, mostly due to having a greater amount of neurons. A failure in producing sufficient amount of neurons leads to severe developmental malformations, including microcephaly and lissencephaly, causing critical cognitive impairment and intellectual disability. Cortical neurons are born during embryonic development from neural stem cells, so the proliferative and neurogenic activity of these progenitor cells determine the final size of the cerebral cortex. Recent discoveries reveal that mitochondria play central roles in the regulation of neural progenitor dynamics, where the metabolic regime and the fusion-fission balance determine neurogenesis versus proliferation. Cortical size increased dramatically during evolution from reptiles to humans as a result of increasing the amount and diversity of cortical progenitor cells, and their proliferative capacity. Taken together, these precedents strongly suggest that the evolution of cortical progenitor cells and the expansion in cerebral cortex size may have resulted from the evolution of mitochondrial dynamics and metabolic regime. In this Master project, the candidate will study the subcellular localization and dynamics of mitochondria in embryonic cortical progenitor cells of birds and mammals, and their correlation with proliferation, amplification or neurogenesis in these cell types. Comparison between cortical progenitors in human, ferret, mouse and chick will reveal evolutionary changes with potential relevance in cellular amplification and cortical size expansion.

Methods and technology involved in the MRP/TFM Project:
The student will perform exogenous expression of plasmid DNA in cortical progenitor cells of chick, mouse and ferret embryos, and human organoids, to visualize individual mitochondria in living cells with a fluorophore reporter protein. Cells will then be imaged by live superresolution videomicroscopy, followed by the post-hoc identification of cell types by immunocytochemistry. The subcellular localization and motility dynamics of mitochondria in each cell type will be quantitatively analyzed using Imaris software.

Member/s of the lab who will act as tutor/co-tutor of the project (if different from the group IP): Dr. Adrián Cárdenas (co-Tutor)

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