suggest that the rate of mito fission/fusion/motion events are very slow in vivo, approaching mito protein turnover rates. This in vivo imaging technology permits classical cell biology experiments on mitochondria dynamics in intact animal models to establish the true physiological function of this important organelle.

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Molecular architecture of mitochondria
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Mitochondrial function and architecture are intimately linked. Functional defects lead to aberrant structure and structural alterations lead to functional defects. The molecular basis of mitochondrial architecture is not well understood; this is largely due to the underlying complexity. Mitochondria are made up by two entirely different membranes, the outer membrane (OM) and the inner membrane (IM). Several structural elements of the IM can be distinguished. The inner boundary membrane (IBM) together with the OM forms an envelope in which both membranes interact in many ways mediating translocation of a large number of components, low and high molecular weight substances, including proteins and nucleic acids. Contact sites (CS) between OM and IBM have been observed by electron microscopy (EM). At crista junctions (CJ), short tubule or slot like structures with high negative membrane curvature, crista sheets or tubules extend from the IBM into the matrix. At crista rims the IM is strongly positively curved. Whereas the structure of the mitochondrial envelope is virtually uniform, the organization of cristae is varying strongly between different cells, tissues and organisms.

In a search for the molecular determinants of mitochondrial architecture we have employed both a mutational and a proteomic approach. Components required for formation of crista junctions and crista rims are Fcj1 (mitofilin) and subunits Sue and Sug of the F1Fo-ATP synthase, respectively. In a systemic proteomic search for components of contact sites a protein complex (MICOS) was discovered which is responsible for both formation of CJ and CS. MICOS is a supramolecular complex of ca. 1.5 MDa and consists of at least six different proteins, among them Fcj1; five of them are transmembrane IM proteins and one is associated with the outer surface of the IM. Immuno EM localized these proteins preferentially to CJ. Deletion of MICOS components leads to complete or partial loss of mitochondrial architecture and respiratory deficiency. MICOS components interact with proteins of the outer membrane, in particular the TOB/SAM complex (the insertase for β-barrel proteins into the OM) and the Ugo1–Fzo1 complex (which is responsible for fusion) and thereby form CS between IBM and OM.

References

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