Bacterial origin of a mitochondrial outer membrane protein translocase : new perspectives from comparative single channel electrophysiology

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Mitochondria are of bacterial ancestry and have to import most of their proteins from the cytosol. This process is mediated by Tom40, an essential protein that forms the protein-translocating pore in the outer mitochondrial membrane. Tom40 is conserved in virtually all eukaryotes, but its evolutionary origin is unclear because bacterial orthologues have not been identified so far. Recently, it was shown that the parasitic protozoon Trypanosoma brucei lacks a conventional Tom40 and instead employs the archaic translocase of the outer mitochondrial membrane (ATOM), a protein that shows similarities to both eukaryotic Tom40 and bacterial protein translocases of the Omp85 family. Here we present electrophysiological single channel data showing that ATOM forms a hydrophilic pore of large conductance and high open probability. Moreover, ATOM channels exhibit a preference for the passage of cationic molecules consistent with the idea that it may translocate unfolded proteins targeted by positively charged N-terminal presequences. This is further supported by the fact that the addition of a presequence peptide induces transient pore closure. An in-depth comparison of these single channel properties with those of other protein translocases reveals that ATOM closely resembles bacterial-type protein export channels rather than eukaryotic Tom40. Our results support the idea that ATOM represents an evolutionary intermediate between a bacterial Omp85-like protein export machinery and the conventional Tom40 that is found in mitochondria of other eukaryotes.
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