Autophagy in Cellular Homeostasis

Jin-A Lee

Autophagy is a lysosome-dependent process that supports cellular adaptation by recycling intracellular material and removing damaged proteins and organelles. This lecture introduces the major forms of autophagy and follows macroautophagy from initiation and membrane expansion to cargo degradation. Particular emphasis is placed on experimental interpretation: an increase in LC3 puncta or LC3-II alone does not establish increased autophagic flux. Complementary imaging, turnover assays, cargo-specific reporters, and genetic approaches are discussed to distinguish cargo capture, delivery to acidic compartments, and degradation. These principles are then applied to neurons, where long-term protein homeostasis, polarized transport, and organelle maintenance must be coordinated. Examples from Alzheimer's and Parkinson's diseases illustrate how defects in autophagic and lysosomal pathways may contribute to protein accumulation, mitochondrial dysfunction, and neuronal vulnerability. These disease contexts also provide a basis for discussing why the effects of autophagy modulation depend on the affected pathway step and cellular state. The lecture concludes with a pharmacological framework that distinguishes molecular target engagement, pathway modulation, and functional benefit, together with emerging strategies for targeted autophagic degradation.