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Cellular polarity in aging: role of redox regulation and nutrition

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Abstract

Cellular polarity concerns the spatial asymmetric organization of cellular components and structures. Such organization is important not only for biological behavior at the individual cell level, but also for the 3D organization of tissues and organs in living organisms. Processes like cell migration and motility, asymmetric inheritance, and spatial organization of daughter cells in tissues are all dependent of cell polarity. Many of these processes are compromised during aging and cellular senescence. For example, permeability epithelium barriers are leakier during aging; elderly people have impaired vascular function and increased frequency of cancer, and asymmetrical inheritance is compromised in senescent cells, including stem cells. Here, we review the cellular regulation of polarity, as well as the signaling mechanisms and respective redox regulation of the pathways involved in defining cellular polarity. Emphasis will be put on the role of cytoskeleton and the AMP-activated protein kinase pathway. We also discuss how nutrients can affect polarity-dependent processes, both by direct exposure of the gastrointestinal epithelium to nutrients and by indirect effects elicited by the metabolism of nutrients, such as activation of antioxidant response and phase-II detoxification enzymes through the transcription factor nuclear factor (erythroid-derived 2)-like 2 (Nrf2). In summary, cellular polarity emerges as a key process whose redox deregulation is hypothesized to have a central role in aging and cellular senescence.

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