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Anti-ageing drugs

Since the theory of ageing as a process in which oxidative stress led to accumulation of damage of the cellular environment over time, first proposed by Harman (1956), we have seen an exponential expansion in our understanding of the ageing process.

Many advances have contributed to our understanding of the ageing process and how to mitigate its effects. Some important milestones have led to a leap in our understanding and these are briefly discussed below. A more expansive explanation of an area that will no doubt lead to the bench-to-bedside transition that we seek as clinicians is provided by Kirkwood and Austad (2000) and by López-Otín et al. (2013).

- Cellular senescence: This phenomenon, whereby cells stop dividing and contribute to the ageing process, has provided a foundation for understanding ageing at the cellular level.
- Discovery of telomeres: These are the protective end caps of chromosomes, and how they shorten as cells divide has shed light on how cellular ageing occurs. Telomere extension refers to the prolongation and preservation of the protective end caps of chromosomes that shorten as cells divide, contributing to cellular ageing. Drugs that extend telomeres are being developed to delay cellular ageing. Several drugs have been shown to affect telomerase activity. For instance, epicatechins, which are flavonoids found in green tea, have been shown to activate telomerase in vitro, with some studies suggesting that they may have potential as a telomere-protective agent.
- Advances in stem cell therapy: These have the potential to replace damaged or ageing cells and improve tissue function, which could help delay the ageing process.
- Lifestyle interventions: A growing body of evidence suggests that lifestyle interventions, such as diet (intermittent fasting and altered nutrient sensing) and exercise, can improve health and potentially delay the ageing process by reducing oxidative stress and inflammation.
- Development of anti-ageing drugs: These target the underlying mechanisms of ageing, such as mTOR inhibitors and senolytics, and hold promise for delaying the ageing process.
  1. mTOR inhibitors: These drugs target the mTOR pathway, which regulates cell growth and division, and are being developed to delay the ageing process and improve longevity.
  2. Senolytics: These drugs target senescent cells, cells that have stopped dividing and are contributing to ageing and disease.
  3. NAD+ boosters: NAD^+ (nicotinamide adenine dinucleotide) is a molecule which is involved in various cellular processes but declines with age.
  4. Sirtuin activators: Sirtuins are a family of enzymes that regulate cellular processes and are involved in ageing. Sirtuin activators are being analysed and created to improve cellular function and delay ageing. Sirtuins are named after the yeast gene Silent Information Regulator 2 (SIRT2), which was the first sirtuin to be identified. There are seven different sirtuins in mammals (SIRT1–7), each with distinct functions and tissue distributions. Some sirtuins have been linked to longevity in various species, and several sirtuin activators are being developed as potential therapies for various diseases and age-related conditions.

Anti-ageing medicine will be a defining area both in mainstream medicine and medical aesthetics as we see more developments over the coming decade, with an estimated doubling of the valuation of this area in terms of revenue from $22.5 to $44.5 billion USD. JAN

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