VON ARDENNE
APPLIED BIOMEDICAL TECHNOLOGIES

From Cancer to Longevity: Whole-Body Hyperthermia as a promising approach for longevity treatments

Introduction

Aging is often defined as the time-dependent functional decline that affects most living organisms. Fueled by groundbreaking discoveries in molecular and cellular biology, aging research has undergone a transformative era in the last decades. Parallel to the advancements in cancer research, aging research is now able to identify fundamental mechanisms (hallmarks) that drive this complex biological phenomenon. At first glance, cancer and aging appear as opposing processes, with cancer characterized by aberrant cellular growth and aging marked by a decline in cellular function. However, both processes share a common root: the accumulation of cellular damage over time. This damage can lead to the development of cancer in some cells, while in others, it contributes to the overall decline associated with aging. Additionally to cancer, several age-related pathologies, such as atherosclerosis and inflammation, also involve uncontrolled cellular growth or hyperactivity.

Whole-Body Hyperthermia as a treatment

Whole-Body Hyperthermia (WBH), a therapeutic approach that gently elevates the body's core temperature to a controlled, feverish range, has emerged as a promising avenue for longevity interventions.

This modality, which has its origins in cancer therapy, harnesses the power of mild artificial fever to trigger a cascade of beneficial responses within the body, promoting cellular repair, enhancing immune function, and improving overall health. Fig. 1 shows the basic physiological effects of a WBH treatment on the human body.

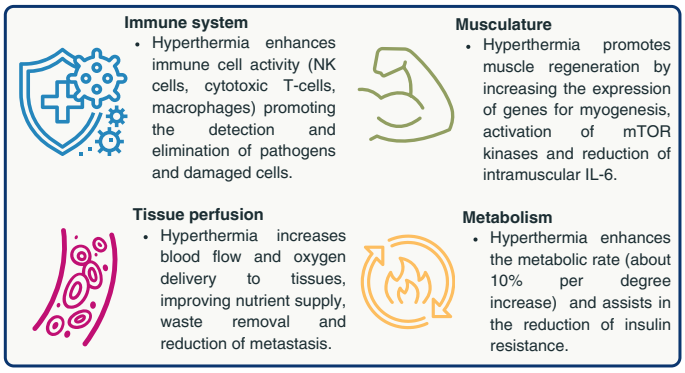
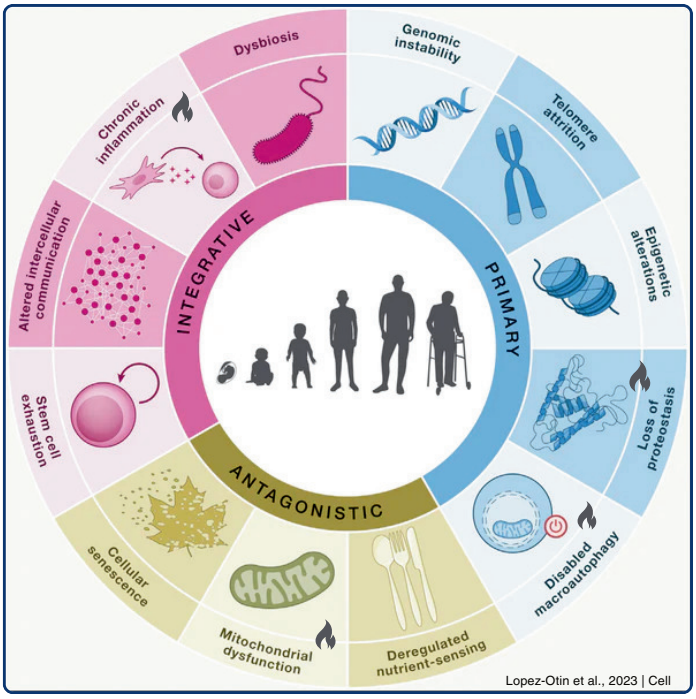


Fig. 1: Physiological effects of WBH on the human body.



scientifically verified efficiency of hyperthermia

Fig. 2: Visualization of the 12 hallmarks of aging. Highlighted with grey fire symbols (🔥) are the hallmarks for which the efficiency of hyperthermia is already scientifically verified and published.

Conclusions

Overall, hyperthermia is a promising therapeutic approach that has the potential to address multiple hallmarks of aging and promote healthy lifespan. Further clinical research is warranted to fully elucidate the mechanisms and therapeutic potential of hyperthermia in combating aging-related diseases.

Decoding the Hallmarks of Aging: A New Therapeutic Approach

In 2013, López-Otín et al. revolutionized the aging research field with a highly developed framework encompassing nine hallmarks of aging. This framework has since been refined and expanded, with the current consensus among aging researchers identifying 12 hallmarks.[1]

These hallmarks, which share three key criteria – manifestation during normal aging, accelerated aging upon aggravation, and retardation of aging upon amelioration – serve as valuable indicators of the aging process and its potential therapeutic targets.

Hyperthermia is emerging as a viable treatment method with a scientifically verified positive influence on at least 4 of these 12 hallmarks of aging (see Fig. 2).

1. **Chronic Inflammation**: Hyperthermia modulates inflammatory pathways, reducing inflammatory cytokine production and promoting anti-inflammatory cytokine expression.[2]
2. **Mitochondrial Dysfunction**: Hyperthermia stimulates mitochondrial biogenesis, increasing mitochondrial numbers and enhancing energy production. It also reduces oxidative stress, which damages mitochondria.[3]
3. **Disabled Macroautophagy**: Hyperthermia activates macroautophagy, the cellular recycling process, removing damaged components and promoting cellular renewal.[4]
4. **Loss of Proteostasis**: Hyperthermia enhances the production of heat shock proteins (HSPs), protecting proteins from damage and promoting proper folding.[5]

References

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[4] McCormick et al (2021). J Appl Physiol. 130: 1–9
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