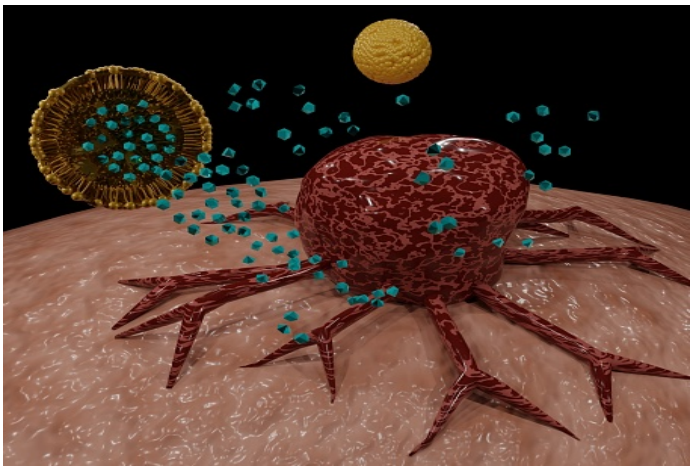
Do you see longevity in medicine as a bipartisan issue and so do you think it can stay that way (...)?

(...) That is despite the discord between health care legislation regarding health insurance in general tends to be, I would say, a politically neutral issue. No one is immune to aging and chronic diseases that are developing, therefore these issues impact everyone, there is some order of fairness there and sometimes unwelcome fairness.

There is broad support for advances in this area. The polls that you did earlier this year show that. I think 73% of those polled believe that human lifespan should continue to increase if advances in medicine and technology allow. A strong majority also approve research into the causes of cellular aging to better treat chronic diseases.

Paul Tonko, Congressman of the 20th district of New York , A4LI Policy Discussion, 29 juin 2022.

Theme of the month: Nanomedicine in aging



Nanoscience and nanotechnology (NST) can be described as all investigations and procedures for the fabrication and manipulation of physical, chemical or biological structures, materials devices and systems at the nanoscale.

The National Nanotechnology Initiative defines it as the manipulation of matter with at least one dimension sized from 1 to 100 nanometers.

Nanomedicine

Nanomedicine is the application of nanotechnology in the field of medicine. The term appeared in 1999 with a first mention by the American scientist Robert A. Freitas Jr. in his book Nanomedicine: basic capabilities.

Although nanomedicine is still in its basic stage, some applications have been made in medical practice, among them, we can mention: biosensors,

medications, diagnostics tools, gene Therapy , development of nanocapsules to aid in cancer treatment, and nanobots…

Applications and uses of nanomedicine in medical field and aging research

1. Nano biosensors

Our body is a sum of biological and biochemical processes. The aging process is made of a deterioration and unpaired in those mechanisms. However , it is difficult to analyze biological data as an electrical signal.

Recent advances in biomanufacturing technology may allow sensors to achieve the required high spatial sensitivity and bring us closer to realizing devices with such potential, which would truly benefit medical diagnosis. Therefore, nanobiosensors could achieve such capacity.

A biosensor is an analytical device that incorporates a biologically active element with a suitable physical transducer to generate a measurable signal proportional to the concentration of chemical species in any sample. Such a device is ideally capable of a continuous and reversible response and should not be harmful to the sample used. The term "nanosensor" refers to a system in which at least one of the nanostructures is used to detect gases, chemicals, biological agents, electric fields, light, heat, etc. Nanobiosensors are sensors in which the detectors are biological elements..

Nanobiosensors are devices designed to detect a specific biological analyte by converting a biological entity (protein, DNA, RNA) into an electrical signal that can be detected and analyzed.

The nanobiosensors may be seen as sophisticated laboratory machines capable of rapid, accurate and convenient measurement of complex biological interaction.

Their potential has been used for rapid detection of autoimmune diseases which could significantly prevent irreversible tissue damages and increase the quality of life in these patients. As it is also well known, the biology of cellular senescence is one of the important topics in aging research. The use of biosensors to measure, monitoring of individual living cells could simplify the study of individual living cells and be useful for research on cellular senescence.

Other characteristics of biosensors are that they are able to distinguish multiple analytes in a single sample and detect analytes in solution at very low concentrations.

One another use of biosensors at molecular level is the DNA nanobiosensors which provide powerful tools for rapid and sensitive determination of pathogens, diseases, genetic disorders, drug screening, and other in vitro diagnostics applications. They allow an early diagnosis, even before the appearance of clinical symptoms.

2. Nanotechnology and gene therapy in aging research

Various anti-aging studies in models show that gene therapy has been useful in extending the lifespan of an organism. Various genetic interventions, including mutation, knock-out and overexpression, have been shown to extend the lifespan of some animals.

But now let's talk about gene therapy in humans and the influence of nanotechnology on it and how it can benefit aging research.

Gene therapy consists in genetically modifying genes for therapeutic purposes. Initially, gene therapy was intended to replace a pathogenic gene in monogenic diseases, i.e. those linked to the dysfunction of a single gene. It consisted of delivering to the cells a healthy gene capable of replacing the sick gene. With new advances, other applications have emerged such as the inactivation or elimination or repair of a pathogenic gene that does not function properly. It can be performed directly in the human body (in vivo) or the cells can be genetically modified in a laboratory and then reinjected into the patient (ex-vivo).

There are a variety of types of gene therapy products, including: Plasmid DNA; Viral vectors; Bacterial vectors; genome editing technology; Patient-derived cellular gene therapy products.

Nanotechnology has advanced gene therapy through the development of nanoparticles as gene therapy carriers. Nanoparticles made up of artificial polymers, proteins, polysaccharides and lipids have been developed for the delivery of therapeutic deoxyribonucleic acid (DNA) or ribonucleic acid (RNA) sequences to target cancer.

Basically biodegradable nanoparticles have been used as a capsule to deliver genes into cancer cells. Even with these nanoparticles, the displacement of DNA from the cytoplasmic membrane of cells to the nucleus remains one of the major obstacles to gene therapy. However, the implementation of nanoparticles as gene therapy vectors is one of the most prominent technologies in biomedical research due to the facility and simplicity of their synthesis and functionalization with several components, their low immunogenicity and toxicity. Their success in cancer treatment is well known. It should be further developed and used in aging research.

3. Nanocapsules in cancer treatment

As mentioned earlier, the use of nanoparticles has been crucial for gene therapy, and even more useful in gene therapy on cancer cells. In nanotechnology, nanoparticles are not only used to modify genes in cancer cells, but also to deliver drugs into cancer cells.

Technically, the nanoparticles are equipped with nanocarriers that guide the ultrafine particles towards the tumor cells. The nanoparticles targeting the tumor cells are only absorbed by the latter, where they release their medicinal effect to eliminate them. For the quality mentioned in the previous paragraph, nanoparticles are actually beneficial to cells, because they act precisely on a specific cell without damaging the surrounding tissue. In fact, the FDA has approved the use of gene therapy and cell therapy drugs in the treatment of certain cancers.

4. Nanobots

A nanorobot or nanobot is a robot whose components are at a nanometric scale (10^{-9} meters). Generally the size of nanobots lies between 1 to 100 nm. Nanorobots can be used very actively in medicine for prior diagnosis and targeted drug-delivery for cancer, surgery, pharmacokinetics, monitoring of diabetes and biomedical instrumentation.

Another useful application of nanorobots is to cooperate in tissue cell repair after tissue injury, working with white blood cells and inflammatory cells.

Some others function of Nanorobots are:

- Bacteria detection
- Detect Cancer
- Determines the Effectiveness of Drug
- Detect Particular Chemicals
- Deliver Cancer-Fighting Drugs
- Clear Blocked Blood Vessels
- Serve as Antibodies
- Clean Up Pollution

Precise drug delivery and low side effects are some of the advantages of nanorobots. The high cost of production is one of the disadvantages.

Conclusion

We live in difficult covid times. We do not use enough nanotechnologies to defeat this disease and we regress in some health dimensions (see below).

But we are in an era of new discoveries with new technologies. Scientists like Eric Drexler, Richard Feynman, Robert Freitas, have believed in the progress of nanotechnology and the benefits of these advances for the world. Also research against aging could benefit from an advance catapulted with these new technologies. Today, nanoparticles already have multiple uses in different branches of medical science. They have been analyzed for different clinical applications, such as drug carriers, gene therapy in tumors, contrast agents in imaging and diagnostic devices capable of transforming biological data into measurable electrical data. The risks and benefits have yet to be studied, but the scientific advances of nanotechnologies could be of crucial help in the medical world.

Bad news of the month

The disastrous decrease in life expectancy at world level in 2020 and 2021 has been recently confirmed by the United Nations in a document called World Population Prospects 2022.

Global life expectancy at birth fell to 71.0 years in 2021, down from 72.8 in 2019, due mostly to the impact of the coronavirus disease (COVID-19) pandemic. (...) In Central and Southern Asia and in Latin America and the Caribbean, life expectancy at birth fell by almost three years between 2019 and 2021. (...) For Bolivia (...), Botswana, Lebanon, Mexico, Oman and the Russian Federation, estimates of life expectancy at birth declined by more than 4 years between 2019 and 2021.

Health technologies still progress worldwide. However, we urgently need a larger use of those health technologies, more trusted health authorities, more use of big data for longevity and resilience in order to have health technological progress creating again a global rise in healthy life expectancy.

Other scientific news in June and July from Heales.

For more information

- Heales, SENS, Longevity Alliance, Longecity & Lifespan.io
- Heales Monthly Science News
- Source of the images n°1 & n°2