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Carbon nanotubes and HIV: how far are we from a cure?

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Abstract: HIV-1 is a difficult infection to treat. However, the use of nanomaterials and nanobiotechnology has generated important advances in this area. Carbon nanotubes (CNTs) are an emerging field with potential for HIV-1 diagnosis and treatment, however, a major concern, is reducing the toxicity and increasing the biocompatibility of CNTs for medical applications.

Objectives: This study investigated the advances and challenges of using CNTs in HIV cure, highlighting the opportunities, and their anti-HIV therapeutic potential.

Results: CNTs AS AN ANTIVIRAL ACTIVITY, using sulfuric acid and carboxylic nitric acid oxidation methods, more hydrophobic and dispersed nanotubes can be obtained, consequently increasing their antiviral activity. CNTs exhibit superior antiviral nature to common ARV antiretrovirals, mainly due to their physicochemical and morphological properties. CNTs act as IMMUNOESTIMULATORY, when treated with ammonium group, inducing immune activation and upregulation CD25, IL-6, CD14. these processes promote a profound modulation of inflammatory molecules such as TLR, IL-6, TNF, DC maturation. CNTs can be used as immunotherapeutic molecules due to their powerful immunostimulatory effect. CNTs, besides having inherent immunological activity, act as ADJUVANT IN VACCINE systems especially since they stimulate the innate immune response by activating macrophages and dendritic cells, which process antigens and promote a humoral response. However, CNT presents a major challenge, namely toxicity. The biggest challenge is the formation of aggregation bundles that can bind to various plasma proteins and induce different inflammatory kitokynes. This increases the expression of the inflammatory IL-1B caspase 1 gene as ROS and apoptosis. To avoid this, it is important to be careful with functionalization methods, acoupling proteins and oligonucleotides by covalent functionalization methods, which can increase solubility.

Conclusions: The use of CNTs in the treatment or cure of HIV infection provides unprecedented advances in the battle against this virus, so improving the understanding of these nanosystems, especially related to eliminating their toxicity, represents the holly grail.

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