Nanovesicles: synthetic targeting is good, but bio-inspired is better

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Nanomedicines were born in order to overcome several limitations of conventional therapies such as drug concentration-related toxic effects and non-specific targeting features. Although its efficacy is still widely debated, this medicine branch has demonstrated how the infinitely small can obtain infinitely big results.

The versatility of nanomedicine led to the realization of a wide nanoplatform, where the lipid-based nanovesicles have played one of the main roles since 1964. Currently liposomes are the most known synthetic nanovesicles, whose structure resembles the biological membranes, in terms of phospholipids' conformational disposal. Moreover, they are characterized by cheap fabrication methods and easy surface functionalization. In particular, this last feature can be exploited for providing active targeting capability by including specific moieties into the structure with high affinity for the targeted sites. These targeting moieties, such as antibodies, aptamers or peptides, would enhance all the passive targeting mechanisms, by providing tissue-specific accumulation, particularly useful in the oncological therapies.

The concept of precision medicine was later introduced as an advanced goal of researchers, who applied the physicochemical approach to biology with the purpose of developing highly efficacious nanotherapeutics according to the patients' needs, also guaranteeing the safety. In this context, extracellular vesicles (EVs) represent a turning point into the treatments based on cell-mimetic approaches. Indeed, EVs, acting as cell-cell and organ-cell communication shuttles, show a similar phospholipid structure of synthetic nanovesicles, but their natural surface decoration reflects the same surface architecture of the parent cells. For this reason, they provide intrinsic tissues' recognition properties and overcome all the disadvantages related to the use of cells into the therapies.

Starting from the critical issues belonging to both categories of nanovesicles, further developments in terms of engineering methods have been carried out recently, i.e. the post EV isolation hybridization with liposomes, which led to combine their beneficial features.

In these attempts, hybrid nanosystems may represent a huge step forward in the realization of precise and personalized therapies.