SMART NANOPARTICLES FOR THE DELIVERY OF BIOACTIVE COMPOUNDS

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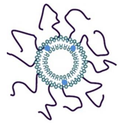
A wide range of nanomaterials based on organic, inorganic, lipid, protein, or synthetic polymers have been employed for the development of new cancer therapeutics. In particular, in the Department of Drug Science and Technology the following nanovectors have been developed and fully characterized

LIPOSOMES

Liposomes are nanoconstructs consisting of natural or synthetic phospholipids surrounding a water core. A number of different approaches and preparation methods are available to encapsulate hydrophilic and hydrophobic drugs.
Liposomes were used as anticancer drug delivery systems. Different drugs were encapsulated in liposomes, such as paclitaxel, docetaxel, gemcitabine, their prodrugs, etc. To further improve their target ability liposomes have been decorated with vectors (antibodies, peptides, hyaluronic acid and folic acid) able to recognize receptors overexpressed on the target cancer cells.



SOLID LIPID NANOPARTICLES

Solid lipid nanoparticles (SLN) are composed of a solid lipid matrix (i.e. glycerides, fatty acids, or waxes) and are stabilized by physiologically compatible emulsifiers, such as phospholipids, bile salts, polysorbates, polyoxyethylene ethers, or polyvinyl alcohols.

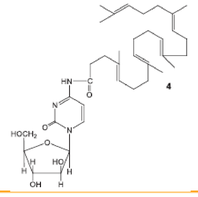
Drugs can be encapsulated in SLN in different ways, depending on the preparation method employed. However, in all preparation techniques, an interaction occurs between drug and lipid, which leads to entrapment.

POLYMERIC NANOPARTICLES

Polymeric nanoparticles that can be nanospheres (matrix systems in which the drug is dispersed within the polymer, throughout the particle) and nanocapsules (vesicular systems in which the drug is located in an inner cavity surrounded by a thin polymer layer).
PEGylated poly(alkylcyanoacrylate) (PACA) polymers were used to obtain biodegradable nanospheres and nanocapsules by nanoprecipitation. Folic acid was then conjugated on the surface of nanoparticles to achieve an active targeting towards cancer cells. In collaboration with the Turin Polytechnic polymeric nanospheres and nanocapsules were also prepared *via* solvent displacement in confined impinging jets reactors (CIJR).

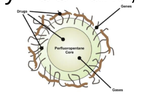
SQUALENE NANOASSEMBLIES

The covalent linkage of a squalene tail to drugs provides bioconjugates which spontaneously self-organize into nanoassemblies in water. The first molecule linked to squalene was gemcitabine. Then, the property of amphiphilic squalenoyl conjugates to form nanoparticles was extended to other anticancer agents, to antiviral drugs and to probes. Another squalene derivative was added to squalene anticancer nanoparticles to obtain actively targeted drug delivery systems.



MICROBUBBLES AND NANOBUBBLES

Recently, microbubbles and nanobubbles, spherical gas-filled core-shell structures, have attracted increasing attention as agents for bioactive compounds. The shell may be composed mainly of lipids or polymers, whereas the core may be filled with various gases, such as perfluorocarbons, sulfur hexafluoride, air, or carbon dioxide). Nanobubbles have mean diameter in the nanometer order of magnitude, while microbubbles have mean diameter in the 1 e 6 μm range. The latter are currently on the market as contrast agents for ultrasound (US) imaging, because they undergo volumetric oscillations or acoustic cavitation when insonified by US and, importantly, they resonate at diagnostic frequencies.



EQUIPMENT

The group is equipped with laboratories for organic synthesis, radioactive synthesis of proteins and organic compounds with instruments for product characterization including NMR spectrometer, mass spectrometer, HPLC-MS, HPLC-DAD, HPLC-FL and UV-visible spectrophotometer. Equipment for the preparation of particulate carriers and for their physico-chemical characterization through nano- and zetasizer measurements, differential scanning calorimetry, field-flow fractionation are also available. The Unit has established a cell culture laboratory (phase contrast microscope, betacounter, electrophoresis and blotting apparatus) equipped for radioactive testing. Animal house are also available with full access. Equipment at Nanostructured Interfaces and Surfaces (NIS) inter-departmental center (University of Torino; www.nis.unito.it).