Targeted Mesoporous Silica Nanoparticles as Smart Vehicles for Highly Selective Drug Delivery

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The use of nanomaterials for cancer treatment has revolutionized chemotherapy, improving drug efficacy and safety, while reducing side effects. Mesoporous silica nanoparticles (MSNs) offer unique advantages, including tunable pore size and shape, easy surface functionalization, high loading capacity, and excellent biocompatibility, making them a promising platform for cancer therapy. In this context, after an accurate description of the biological interactions occurring between our very first folic acid (FOL) grafted MSN-based nanodevice (FOL-MSN) and cells overexpressing or not the folate receptor (FR), an overview of our most advanced prototypes potentially useful for the targeted therapy will be given. Starting from the very promising *in vitro* and *in vivo* data of a totally engineered mesoporous silica-based nanocarrier for the targeted delivery of bortezomib to multiple myeloma, a mention will be given to the ongoing studies on a MSN-based solution for the targeted delivery of the widely used anticancer drug doxorubicin to FR-expressing cells, as well as to the preliminary data on a doxorubicin-loaded prototype, featuring a peptide ligand that selectively recognizes HER2/neu overexpressing cells. Finally, a perspective study, proposing an ambitious, as well as exiting, poly-pharmacological approach using Molecular Multi-Targeted Nanostructured anti-cancer therapeutics will be presented.

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