Patient-specific nanovectors against glioblastoma multiforme

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The current advances in nanotechnology allows for a wide spectrum of possible applications in different fields, in particular in medicine. Nanoparticles can be exploited as efficient drug delivery systems thanks to their capacity to encapsulate high payloads of drugs that are otherwise poorly soluble in the biological milieu, increasing their bioavailability and biocompatibility. In other cases, nanoparticles can act themselves as a therapeutic or diagnostic agent (*e.g.*, superparamagnetic iron oxide nanoparticles, -SPIONs-). Nanostructured lipid carriers (NLCs) offer several advantages as compared to other systems, such as a relatively easy, green, low-cost, and scalable preparation protocol, biocompatibility / biodegradability ensured by the lipid constituents, a high drug payload, and physicochemical stability in bodily fluids.

We demonstrated that NLCs loaded with SPIONs and a chemotherapeutic agent are able to selectively induce apoptosis in glioblastoma multiforme cells [1, 2]. Moreover, NLCs functionalized with the peptide angiopep-2 and encapsulating temozolomide have been efficiently exploited in an *in vivo* approach to promote suppression of human glioblastoma by the synergistic action of the chemotherapeutic drug loaded into the nanocarrier ([NLCs]=24 mg/[TMZ]=0.98mg /kg weight mice; injection volume= 3 µL) and the cell sensibilization in response to the local heating ($H \times f$ = $4.2 \cdot 10^9$ A/ms, t = 30 min, 3 consecutive days, 24 h after NLC intratumoral administration). Obtained data on orthotopic U87MG human glioblastoma tumor-bearing nude mice evidenced an effective suppression of the tumor growth, and a significantly improved medium survival time after the treatment (75% of the subjects still alive at the end of the study), suggesting the suitability of the proposed nanoplatform for the GBM treatment [3].

In the aim of reaching full targeting potential and provide a patient-personalized treatment, we are now working on developing new nanocarriers based on NLCs and coated with extract of glioblastoma cell membranes derived from patients' samples. Cancer cell membrane coating confers extraordinary targeting abilities to the nanovectors, increasing the accumulation of therapeutics in diseased tissues and significantly reducing side effects [4]. These nanovectors co-deliver both SPIONs, for hyperthermia treatment, and chemotherapeutic drugs. The targeting efficiency, the ability of crossing the blood-brain barrier, and the selective anticancer activity of the nanovectors are studied by means of state-of-the-art fluidic systems to closely mimic the complex tumor microenvironment *in vitro* [5].
This work will be of great importance in the development of new technologies for precision medicine and for theranostic applications, thanks to abilities of SPIONs to act both as a therapeutic tool and as a magnetic resonance imaging -MRI- contrast agent, depending on the magnetic field used. Moreover, thanks to the versatility of the formulation and testing tools, this new approach could be easily remodeled to be applied for the treatment of other oncological pathologies.

References

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