Nano Today (2013) xxx, xxx—xxx

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/nanotoday

NEWS AND OPINIONS

Carbon nanotubes target tumors in two steps

Cordelia Sealy

Single-walled carbon nanotubes (SWNTs) can carry loads 100 times larger than other delivery agents and are also eliminated quickly from the body, making them ideal for delivering cancer drugs to tumors. Researchers led by David A. Scheinberg at the Memorial Sloan-Kettering Cancer Center demonstrate the potential of this approach using a two-step process [Mulvey, J.J., et al., Nature Nanotechnology (2013), http://dx.doi.org/10.1038/nnano.2013.190].

''When soluble and injected, SWNTs do not appear to be toxic on their own,'' says Scheinberg. ''We took advantage of these unusual properties of SWNTs to make a drug carrier.''

In the two-step process (Fig. 1), cancer cells are first pretargeted with antibodies that have been modified with short strands of a DNA-like molecule called morpholino oligonucleotide. SWNTs, meanwhile, are labeled with complementary strands of the DNA analog that bind onto antibodies on cancer cells, enabling the delivery of therapeutic or imaging agents.

Two-step targeting or 'pretargeting' is an attractive approach for cancer because the slower pinpointing of suspect tissue can be separated from the quick delivery of potentially cytotoxic treatment agents, which need to be cleared from the body as rapidly as possible. The tactic could have important advantages over one-step processes.

''The one-step targeting approach with a nanoparticle typically leads to the accumulation of the drug or agent at a clearance site in the body such as the liver, leading to increased risk of toxicity,'' explains Scheinberg.

In a mouse model system with xenografted human lymphoma tumors, the SWNT carriers labeled with radioisotopes appear not only effective in targeting and treating tumors but are also rapidly cleared from the body via the kidneys.

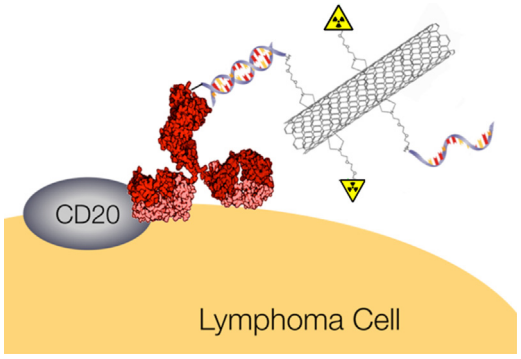

Figure 1 A tumor-selective monoclonal antibody, for example directed to CD20- a protein on lymphomas and leukaemias, carries a DNA address tag to the tumor cell. Next, the CNT with the complementary DNA address tag, carrying a cytotoxic warhead, delivers the payload to the tumor.
[Courtesy of David A. Scheinberg, Memorial Sloan-Kettering Cancer Center.]

Although the approach appears to be effective with three different types of cancer cell explored by the researchers *in vitro*, Scheinberg admits the pharmacokinetics are far from simple and will require considerable effort to optimize. Alternatively, SWNTs could be used to deliver RNAi to tumors or carry vaccine targets, which can be rapidly internalized into cells. Kostas Kostarelos of The University of Manchester believes Scheinberg's pretargeting approach warrants further investigation. ''[The work] is an illustration of how we can take advantage of the interesting features of the pharmacology of nanofiber-shaped structures for therapeutic purposes,'' he told Nano Today.

E-mail address: cordelia.sealy@googlemail.com

1748-0132/$ — see front matter
http://dx.doi.org/10.1016/j.nantod.2013.10.004