A Short Note on Targeted Drug Delivery

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EDITORIAL

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DESCRIPTION

Nanocarriers are useful for the drug delivery process because they're going to deliver drugs to site-specific targets, allowing drugs to be delivered in certain organs or cells but not in others. Site-specificity could also be an important therapeutic benefit since it prevents drugs from being delivered to the wrong places. For instance chemotherapy drugs are often extremely toxic to human cells, it's important that they're delivered to the tumor without being released into other parts of the body. Methods for nanocarriers to deliver drugs include passive targeting, active targeting, pH specificity, and temperature specificity.

Passive targeting

Passive targeting refers to a nanocarrier's ability to travel down a tumor's system, become trapped, and accumulate within the tumor. This accumulation is caused by the improved permeability and retention effect which refers to the poly ethylene oxide (PEO) coating on the surface of the many nanocarriers. PEO allows nanocarriers to travel through the leaky vasculature of a tumor, where they're unable to escape. The leaky vasculature of a tumor is that the network of blood vessels that form during a tumor, which contain many small pores. These pores allow nanocarriers in, but also contain many bends that allow the nanocarriers to become trapped. As more nanocarriers become trapped, the drug accumulates at the tumor site. This accumulation cause large doses of the drug to be delivered on to the tumor site. PEO also can have some adverse effects on cell-nanocarrier interactions, weakening the results of the drug, since many nanocarriers must be incorporated into the cells before the drugs can be released.

Active targeting

Active targeting involves the incorporation of targeting modules like ligands or antibodies on the surface of nanocarriers that are specific to certain sorts of cells round the body. Nanocarriers have such a high surface-area to volume ratio allowing multiple ligands to be incorporated on their surfaces. These targeting modules leave the nanocarriers to be incorporated directly inside cells, but even have some drawbacks. Ligands may cause nanocarriers to become slightly more toxic because of non-specific binding, and positive charges on ligands may decrease drug delivery efficiency once inside the cells. Active targeting has been shown to assist overcome multi-drug resistance in tumor cells.

pH specificity

Certain nanocarriers will only release the drugs they contain in specific pH ranges. pH specificity also allows nanocarriers to deliver drugs on to a tumor site. Tumors are generally more acidic than normal human cells, with a pH around 6.8. Normal tissue features a pH of around 7.4. Nanocarriers that only release drugs at certain pH ranges can therefore be utilized to release the drug only within acidic tumor environments. High acidic environments cause the drug to be released because of the acidic environment degrading the structure of the nanocarrier. These nanocarriers won't release drugs in neutral or basic environments, effectively targeting the acidic environments of tumors while leaving normal body cells untouched. This pH sensitivity can also be induced in micelle systems by adding copolymer chains to micelles that are determined to act during a pH independent manor. These micelle-polymer complexes also help to stop cancer cells from developing multi-drug resistance. The low pH environment triggers a fast release of the micelle polymers, causing a majority of the drug to be released directly, instead of gradually like other drug treatments. This quick release mechanism significantly decreases the time it takes for anticancer drugs to kill a tumor, effectively preventing the tumor from having time to undergo mutations which may render it drug resistant.

Temperature specificity

Some nanocarriers have also been shown to deliver drugs more effectively at certain temperatures. Since tumor temperatures are comparatively greater than the temperatures of remaining body, around 40 °C, this gradient helps to safeguard tumor-specific site delivery.