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Overcoming brain barriers through surface-functionalized liposomes for glioblastoma therapy; current status, challenges and future perspective

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Abstract

Glioblastoma (GB) originating from astrocytes is considered a grade IV astrocytoma tumor with severe consequences. The blood-brain barrier (BBB) offers a major obstacle in drug delivery to the brain to overcome GB. The current treatment options possess limited efficacy and maximal systemic toxic effects in GB therapy. Emerging techniques such as targeted drug delivery offer significant advantages, including enhanced drug delivery to the tumor site by overcoming the BBB. This review article focuses on the status of surface-modified lipid nanocarriers with functional ligands to efficiently traverse the BBB and improve brain targeting for successful GB treatment. The difficulties with surface-functionalized liposomes and potential future directions for opening up novel treatment options for GB are highlighted.

Keywords: blood–brain barrier; blood–tumor barrier; delivery challenges; glioblastoma; surface-modified liposomes.

Plain language summary

This review article discusses emerging strategies to overcome glioblastoma (GB), the deadliest form of brain cancer. Current treatment options show limited efficacy against GB with a high potential for side effects. Liposomes are a targeted drug-delivery system transporting anti-GB drugs to the target tumor cells. They are made of tiny particles of fat. However, barriers between the blood and brain and the tumor can prevent standard liposomes from reaching the target area. This is due to the size of these particles and their neutral charge. New strategies have been introduced to modify standard liposomes by including functional features on the surface of liposomes to change their properties. As a result, surface-functionalized liposomes overcome blood–brain barrier and blood–tumor barrier resistance to the transport of anti-GB medication. Hence, a sufficient amount of the drug reaches the brain and is localized in the target tumor area, resulting in improved GB therapy with a lower potential for systemic side effects. However, further research is needed to explore the use of surface-functionalized liposomes against GB before they are used to treat real patients.