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Advanced nanomedicine for cancer diagnosis and therapy

Aswathy Krishnan R

Theranostics is the combination of therapy and diagnostics. This combination of multiple treatment modalities can be achieved with the help of nanotechnology. Nanotheranostics is a multimodal platform with a combination of either therapeutic agents (chemical or genetic drug), imaging agents (photosensitised nanoparticles) or ligand/carrier molecules. Nanoparticles with their unique properties can be tweaked and modified to work as a system and can be applied as a therapeutic and diagnostic tool. The pair modes of drug delivery utilised by anticancer therapy are specifically known as active and passive targeting. Due to the distinctive nature of the tumour microenvironment, it is advantageous for nanoparticle-based drug delivery systems to reach the target site because of the enhanced permeation and retention. Active targeting of the nanoparticles is composed of targeting ligands to enhance site-specific targeting. Generally, nanotheranostic systems are utilised for features, such as real-time drug monitoring, non-invasiveness, reduced toxicity, faster clearance and vascular permeability. Pre-existing treatment modalities for cancer, such as computed tomography (CT), magnetic resonance imaging (MRI) and positron emission tomography (PET) are disadvantageous due to their high radiation levels and high cost. Such imaging techniques use a contrast agent (e.g. iodine) which can be substituted with suitable probes (gold nanoparticles) for enhanced depth of penetration, spatial-temporal resolution, and better visualisation during imaging. Superparamagnetic iron oxide nanoparticles are used for better visualisation in MRI scanning. There are a plethora of nanoparticles that can be used for anti-cancer applications, such as ceramic nanoparticles, which do not swell or change porosity with a change in pH. Therefore, it can be concluded that theranostic nanoparticles are widely researched as they can be utilised in the development of personalised medicine which would help in diagnosing and treating cancer at the earliest stages.

Keywords: Nanotheranostics, Tumour microenvironment, Photosensitised nanoparticles

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