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Nanomedicine Redefining Cancer Therapeutics: The Evolution of Precision Drug Delivery Systems

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With the advent of nanomedicines including drug delivery carriers such as nanoparticles, liposomes, nanoemulsions, and micelles, there has been a paradigm shift in the sphere of cancer treatment. These nano-biosystems have been the focus of scientific research in recent years due to their biocompatibility, low toxicity, higher retention time, bioavailability and higher targeted efficiency as compared to conventional therapeutics such as chemotherapy, radiotherapy and immunotherapy. These conventional therapies not only target cancerous cells but negatively affect neighboring health cells as well comprising the individuals' immune health. Therefore, nanomaterials have been considered the foremost strategy to combat different types of cancer. To facilitate delivery and provide a "stealthy character" to nanomaterials, biomimetic (cell-derived) surface coatings and encapsulations have been developed. Red blood cell mimetic nanoparticles have been designed to successfully inhibit the growth and metastasis of breast carcinoma. Similarly, HeLa cell membrane-derived vesicles of GdTPP/ZnTPP porphyrin nanocomposites have been utilized for photodynamic therapy (PDT) for cervical carcinoma [1]. In addition, ferritin-based and vault-protein nanocarriers have been designed using recombinant engineering techniques to overcome the barriers of multidrug resistance and in-vivo drug delivery reducing immune response and increasing the effectiveness of anticancerous drugs. These functionalized nanocarriers have been reported against glioma, melanoma, hepatocarcinoma, adenocarcinoma and lung cancer [2]. A considerable number of nanomedicines have passed clinical trials and been approved for commercial use by various regulatory organizations. The most recent being the NanoTherm, an EMA-approved nanomedicine for glioblastoma, prostate cancer, and pancreatic cancer. It is a superparamagnetic iron oxide nanoparticle covered with aminosilane [3]. With precision, efficacy, and promise for both patients and clinicians, nanomedicine is a sign of a new era in cancer therapies. Harnessing the potential of nanomedicine demands teamwork, innovation, and transforming ground-breaking research into game-changing clinical applications as we navigate this rapidly changing landscape. With the goal of bringing targeted, personalized cancer treatments closer to reality, this editorial seeks to highlight the unmatched potential of nanomedicine in transforming drug delivery paradigms.

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