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COMMENTARIES

Gold Mines: Towards Cancer Rescue

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Abstract

Cancer remains as a major threat, despite of several pandemic outbreaks. The risk of every alternative disease or disorder increases with the initial incidence of cancer. Cancer treatment has radically changed a lot from conventional therapies like surgery and radiotherapy to targeted therapies like thermal ablation and gene therapy. The extension of applicative nanotechnology has become promising therapy in Cancer Diagnosis and treatment. The use of gold nanoparticles towards cancer therapy is discussed in this article.

Keywords: Nanoparticles- gold nano- oncology

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Cancer

Cancer is an increasing threat in the present days and a serious issue. The most prominent cancers include pancreatic, lung, liver, breast, ovarian, brain, Skin and prostate cancers. Drinking alcohol, smoking, obesity and prolonged exposure to sun rays are the major risk factors for cancer growth [1]. Chemotherapy, surgical removal of tumor, radiation therapy, synthetic lethality, immunotherapy, targeted therapies, angiogenesis inhibitors and hormonal therapy are available treatment strategies of cancer. Chemotherapy is widely used treatment for most of the cancers. However, the current therapies have its own drawbacks. The current challenges of cancer therapy include failure of detection at earlier stages, insufficient drug reaching the site of tumor, non-specific systemic distribution of drug, scanty delivery of drug, multi drug resistance and inability to monitor therapeutic responses. The use of combinational therapy is steadily increasing to treat cancers. Though several anticancer drugs are highly potent in killing cancer cells they fail to reach target site in appropriate concentrations. This warrants the search for new strategies for cancer therapy which is partly contributed by nanotechnology [2].

Nanooncology

Nano Oncology is a blooming cutting-edge Nanotechnology with applications in cancer diagnosis, detection and therapy [3, 4]. Due to cancer heterogeneity and development of drug resistance any particular targeted therapy may not be effective for every population of patients. Smarter understanding and healthy collaboration between cancer biology and nanotechnology is essential to meet the challenges of deadly cancer. Nanoparticles exploit the feature of hyper vascularity and poor lymphatic drainage of solid tumor to target them. Advanced cancers and metastatic diseases, that are resistant to conventional therapies can be profited with the use of active nanoparticle that are efficiently cleared by lungs, liver and MPS after their action [5]. Polymeric micelles, liposomes and albumin NPs have been approved for cancer treatment and other nanotechnology-enabled therapeutic modalities like radiation therapy, gene or RNA interference (RNAi) therapy, immunotherapy and chemotherapy are under clinical investigation.

The efficacy of nanoparticles delivery is drastically improved by coupling with surface ligands or antibodies that localizes to tissue expressing the associated receptors or antigens [6]. Various cancer lines up regulate surface antigens, including fetoprotein, growth factor receptors, such as ErbB2, human carcinoembryonic antigen, and human chorionic gonadotropin antigen, which provide targets for antibody mediated targeting andreceptor interactions. Cancer cells intake the drugs released from nanocarriers. Folate Receptors (FRs) and Transferrin Receptors (TfRs) are overexpressed in bladder, ovarian, colon, lung, kidney and endometrial cancer, hence the vitamin folic acid (folate) and transferrin (Tf) are

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ordinarily used ligands for drug delivery. The chances of interaction and internalization of drug into the cancer cells is greatly increased with the use of nanocarriers. Further the size and surface properties of nanoparticles determine the effectiveness of targeting [7].

Gold Nanoparticles or AuNPs in Cancer

The use of Gold in medicine is been long existingand theprotracted use of nanoparticles in cancer nanotechnology is steadily increasing. Theranostic Nanoparticles with Individualized medicine are in high demand, out of which AuNPs are very attractive. Though gold is very expensive, the synthesis of gold nanoparticles or AuNPs of varied sizes 4-400nm and varied shapes (ribbons, wires, plate, cubic, sphere and rods) is relatively cheaper using safe and reliable methods. The non-toxic and biocompatible nature of AuNPs makes them well persuasive towards cancer therapyImaging, drug delivery, detection of pathogen in food and clinical specimen and photothermal therapy are few biomedical applications [8].

Pancreatic Ductal Adeno Carcinoma (PDAC)

The fourth most threatening malignancies is Pancreatic ductal adenocarcinoma (PDAC). Tobacco usage inherited genetic syndromes, overweight, obesity, diabetes, exposure to chemicals, chronic pancreatitis and liver cirrhosis are most causes of pancreatic cancer. The thick stroma at the site of tumor hinders the delivery of drugs like 5-fluorouracil and gemcitabine to cancer cells and eventually promotes drug resistance. Surgical resection also showed a ray of hope for cure [9]. Gold nanoparticles (AuNPs) were shown to disruptGF-mediated signaling and reversed EMT leading to inhibition of tumor growth in pancreatic and ovarian cancer. Further AuNPs could sensitize PDAC cells to gemcitabine [10].

Liver Cancer

The most common type of liver malignancy is Hepatocellular carcinoma (HCC), that arise from hepatocytes. Patients with advanced cirrhosis, fibrosis and predisposed to hepatitis B are at high risk of developing HCC. People with later age groups, male humans, alcohol abuse, obesity, diabetic and family history are various factors that influence the HCC occurrence. Liver cancer is diagnosed as nodules in ultrasound investigation, quadruple phase computed tomography (CT) scan and Magnetic resonance imaging (MRI). Various therapeutic approaches like liver resection, transplantation, systemic and local therapy aids in cure. Trans Arterial Chemo Embolization (TACE) and Radiofrequency Ablation (RFA) have become prominent clinical tools of therapy [11]. GNPs synthesized with Cajanus cajanphytochemical [3-butoxy-2-hydroxypropyl 2-(2,4-dihydroxyphenyl) acetate] have the potential to induce apoptosis in liver cancer (HepG2) cells. The anticancer drug Doxorubicin is conjugated to GNPs by green synthesis is being used in targeted drug delivery there by reducing the need for targeting agents like pullulan [12]. GNPs produced by thermophilic fungus Humicola spp, were used for drug delivery to liver (hepatic) cancer. A humanized mouse monoclonal antibody conjugated to AuNPs like SM5-1-conjugated NPs are being used for immunotherapy of hepatocellular carcinoma (HCC) [13].

Lung Cancer

Lung cancer includes various risk factors like tobacco usage, exposure to asbestos, radon, arsenic, chromium, nickel and soot. Surgery, chemotherapy and radiation are standard treatment options for lung cancer depending on the stage of malignancy, respectability and overall performance [14]. Gene therapy via nano approach is gaining more importance in cancer treatments compared to the con¬ventional therapeutic approaches due to minimized systematic cytotoxicity. Nano bioconjugate (NBC) constructed, using a photosensitizer (PS) (AlPcS4Cl), AuNPs and Abs showed successful conjugation of the nanocomposite. The PDT effects were enhanced with the use of NBC, showing significant lung cancer destruction to the point of eradication [15].

Breast Cancer

Triple-negative breast cancer (TNBC), with absent or minimal expression of estrogen and progesterone receptors, and human epidermal growth factor receptor 2 are most common in younger women. Mastectomy was carried out based upon tumor size (relative to breast size) Radical mastectomy was used earlier for the treatment of breast cancer detected at earlier stages where mastectomy is usually followed by radiotherapy and/or chemotherapy. Breast conservation therapy (BCT) has come into existence [16]. The complex of Au noanoprticle-AS1411 aptamer-antagomir 155 was used to decrease mir-155 in breast cancer cells [17].

Ovarian Cancer

Ovarian cancer is one of the major leading cause of death in women Ovarian cancer is the most common among gynecological malignancy. Most of the ovarian cancers are of epithelial origin. The first-line treatment for ovarian cancer is cytoreductive surgery. Cisplatin or Carboplatin are used for the treatment of ovarian cancer but unfortunately cancer cells have developed resistance to these drugs [18]. The use of AuNPs targeted to ER (+) breast cancer cells enhanced potency and selective intracellular delivery of tamoxifen. AuNPs–Her enhances the anticancer therapeutic efficacy of Herceptin. Tumor cells embedded with gold can be visualized with Two-photon-induced photoluminescence (TPIP) in vivo. $AuFe_3O_4$ nanoparticles conjugated with a platinum and trastuzumab complex showed target-specific delivery of platinum compounds to HER-2-positive SK-BR-3 cells [19].

Oral Cancer

Oral cancer is one of the most devastating ruinous disease occurring worldwide. Various techniques like micro-satellite analysis, enzyme-linked immunosorbent assay (ELISA) and high-performance liquid chromatography (HPLC) are being used to screen for biomolecules from saliva of suspected patients. Radiation,

chemotherapy and surgery are commonly used therapies for oral cancer [20]. The gold nanoparticles were conjugated to antibodies to enhance the specificity of NPs to target cells. Oncoprotein specific antibodies coated on silica-gold Nano shells were used to target oral squamous cancer cells. Nanoparticles loaded with Doxorubicin and methotrexate showed higher efficiency on squamous cell carcinoma of tongue when compared to free doxorubicin and methotrexate. Gold NPs can enhance 5-fluorouracil drug efficacy in HSC-3 cells via chemo sensitization [21]. Podoplanin-antibody-conjugated gold NPs can facilitate the accumulation of the drug and NPs in the tumor site through active targeting [22].

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• Author declares no conflict of interest

• Study was approved by Research Ethic Committee of author affiliated Institute .

• Study's data is available upon a reasonable request.

• All authors have contributed to implementation of this research.

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