Nanomaterials: Cancer Treatment and Imaging

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***Abstract*—Cancer continues to be a worldwide epidemic afflicting approximately thirteen million people and resulting in just over seven and a half million deaths each year. The implementation of nanomaterials would allow for improved medical imaging techniques and offers a promising alternative to current medicines, in that they specifically target cancer cells for treatment and would significantly reduce the devastating side effects of chemotherapy and radiation.**

I. Introduction

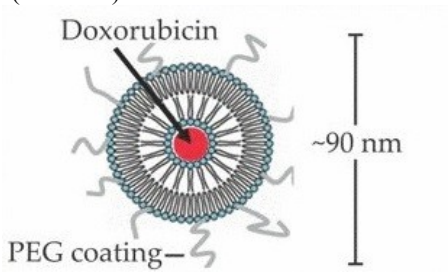
CANCER has perplexed and challenged the medical community for centuries. In 2008, just under thirteen million cancer diagnoses and just over seven and a half million cancer related deaths were reported. Cancers can present in over sixty different organs in the body with over two hundred unique varieties. Cancers devastating effects on the body often require aggressive treatment methods that are often result in a debilitating host of side effects. Modern treatments for cancer include chemotherapy, radiation, Immunotherapy, hormone therapy and surgery and despite their effectiveness in eliminating cancer, many of these therapies also target healthy body cells as well. These blanket treatments can result in hair loss, nausea, a significantly reduced immune system and wide spread pain. Current treatments are limited in that they have no way of specifically targeting the malignancies they are trying to destroy and require patients to deal with the side effects during their treatment. Current imaging techniques to diagnose cancer are also limited in that no single test can accurately diagnose cancer. Diagnostic imaging techniques include CT (Computed tomography) scans, x-rays, MRIs (Magnetic resonance imaging) and ultrasound and an accurate diagnosis often includes additional tests.

II. Methods

Nanomaterials represent the future of cancer treatment and diagnosis. Chemotherapy is one of our most potent weapons against cancer, however the inability to discern cancer cells from healthy cells has left patients treated with chemotherapy debilitated with side effects. Nanomaterials address this issue on a physical level by utilizing the systems of mass transport and fluid mechanics within the body to better target cancer tissues. Nanoparticals are able to directly target cancerous tissues by taking advantage of the enhanced permeability and retention (EPR) effect within tumors, for applications in both imaging and treatment. Specifically targeting these tissues will allow for more potent doses of medications to be administered with significantly less collateral damage to healthy body tissues. Additionally nanomaterials with superior attributes to current dying agents will allow for cancer through the body to be identified more accurately.

III. Results

Doxil, a nano-incarnation of the cancer fighting drug Doxorubicin is one of only two nanomedicines currently approved by the FDA for human treatment. Doxil is comprised of crystalline Doxorubicin encapsulated by a lipid layer and coated with polyethylene glycol. A clinical trial involving women with metastatic breast cancer compared the efficacy of both drugs. The trials results showed that Doxil was as effective as Doxorubicin in treating the cancer with significantly less cardiotoxicity, myelosuppression, vomiting and alopecia (hair loss).



IV. Discussion

The potential use of nanomaterials in cancer diagnosis and treatment is extremely promising. This technology can be used to improve current and even rejected medicines and represents a field with massive potential to better cancer treatment and imaging by offering specific targeting of malignant tissues. Nanomatherials however also have some disadvantages that must be taken into consideration. The manufacturing of nanomaterials is still in its infancy and large scale batch consistency is extremely difficult manage. Minute variations on the nano-scale can lead to potentially harmful side effects and a more complete understanding of the mechanisms within the body that are affected by these nanomaterials will be required before nanomedicines become more widely utilized. Cost is another concern as nanomedecines often cost considerably more than traditional therapies. For example, one dose of Doxorubicin costs approximately two hundred dollars compared to a single dose of Doxil, priced at five thousand dollars. In the future, better manufacturing techniques and quality control may lead to increased availability of nanomedicies as well as additional applications and methods of treatment.

References

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