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A REVIEW PAPER ON NANOTECHNOLOGY-BASED APPROACHES FOR DEVELOPING NOVEL ANTICANCER THERAPIES

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ABSTRACT:

A limitless landscape of solutions responding to critical issues in several fields has been made possible by the flowering of nanotechnology and a broad variety of nanotechnology-based techniques can now be implemented to circumvent the limitations of traditional cancer therapies. In this context, the current stage of nano-technological cancer treatment applications is outlined by the core nano materials as well as the chemical-physical approaches available for their surface functionalization and drug ligands as potential therapeutic agents. The use of nano materials as vehicles for the delivery of different therapeutic substances is recorded to highlight benefits such as high drug loading, pay-load half-life enhancement, and bioavailability. The importance of intrinsic nanomaterial characteristics was especially emphasized. The ability to combine the properties of the transported drug with those of the nano-sized carrier can, in reality, lead to multifunctional theranosis tools.

KEYWORDS: *Cancer, Nanotechnology, Nano, Systems, Therapy, Health care.*

INTRODUCTION

In this view, fundamental examples are carbon quantum dot fluorescence, gold nanoparticle optical properties, and super paramagnetism of iron oxide nanoparticles. Smart anticancer instruments, as in the case of bovine serum amine oxidase (BSAO) and gold nanoparticles, can also be produced by conjugating enzymes to nanoparticles. The goal of the current review is to include an overall vision of nano-technology strategies to resolve the danger of human cancer, including opportunities and challenges.

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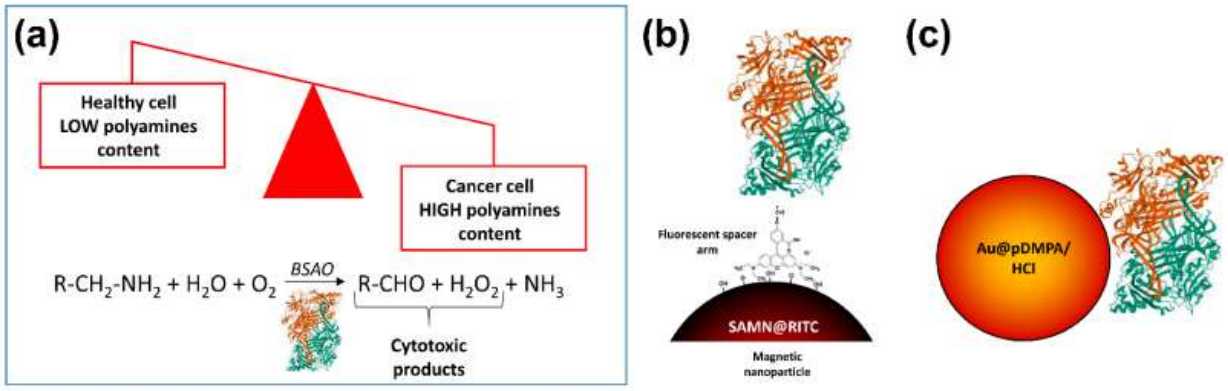

Figure 1: Illustrates the (a) rapidly growing cancer cells, (b) SAMN@RITC-BSAO (c) Core-shell [1]

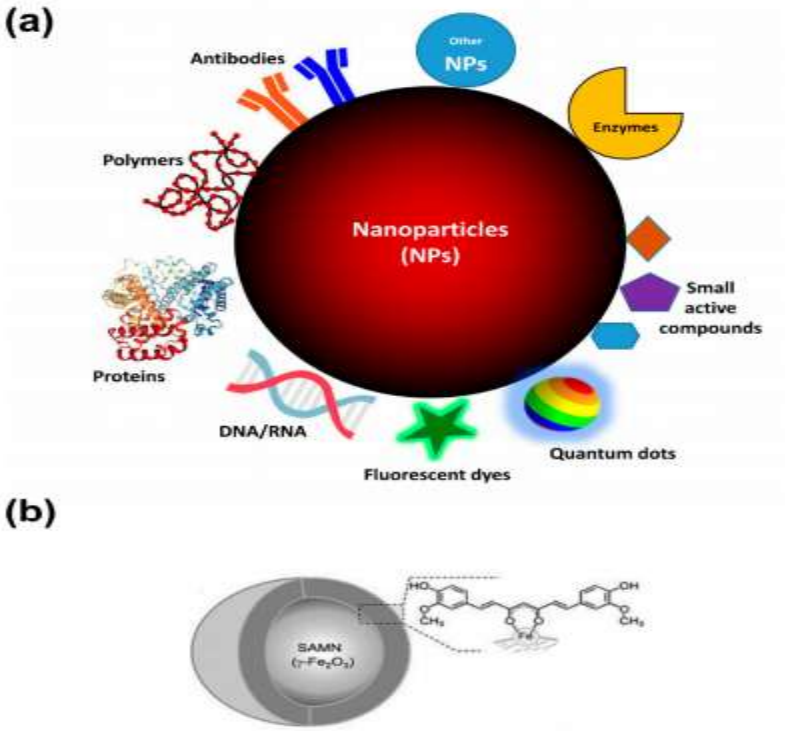

Figure 2: Illustrates the Nanoparticles (a) Schematic illustration of NPs features for anti-cancer activity [2]

While advancements in cancer therapy have improved patients' overall survival rates, new therapeutic strategies are still needed for cancer heterogeneity in order to reduce the burden of this disease and change the prognosis [3]. The standard clinical methods for cancer treatment are

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currently surgery, radiotherapy, and chemotherapy. Nevertheless, the effectiveness of traditional methods fails in some situations, in particular because of challenging anatomical intervention sites or cancer cell chemo-and radio-resistance, which can also facilitate recurrence, metastasis and second primary tumours [4].

Furthermore, the full use of chemotherapy, the most conventional method approved for the treatment of cancer, is in many cases limited, mainly due to the harmful side effects of the indiscriminate action of medicines on cancerous and healthy cells and tissues, as well as the low bioavailability or unfavourable distribution of bioavailability [5]. To date, many therapeutics have been successfully developed for the treatment of cancer and other diseases, leveraging the opportunities created by nano materials. The key advantages of these nanostructures are their high surface to volume ratio, which allows large quantities of targeting ligands and active compounds to be functionalized and prevents their degradation [6].

DISCUSSIONS

Table 1: Illustrates the most used functional groups [7]

Biomolecule Functional Group	Reactive Group	Reaction Product
Aldehyde/ketone	Amines Hydrazine	Imine Hydrazone
(free) Amine	Acyl azides Aldehydes Arylating agents Carbodiimides Carbonates Epoxides Imidoesters *N*-hydroxysuccinimide ester (NHS) Isocyanates, Isothiocyanates Sulfonyl chlorides	Amide Imine Arylamine Amine Carbamate Secondary amine Amidine Amide Urea/thiourea Sulfonamide
Carboxylate	Carbodiimides, Carbonyldiimidazole Diazoalkanes, Diazoacetyl	Amides Esters
Hydroxyl	Epoxides/Alkyl halogens Periodate Isocyanates, Carbonyldiimidazole N,N′-disuccinimidyl carbonate, *N*-hydroxysuccinimidyl chloroformate	Ethers Aldehydes Carbamate or urethane
Reactive carbon (e.g., Tyr)	Diazonium	Diazo bond
(free) Thiol	Acryloyl derivatives Arylating agents Aziridine Haloacetyl/Alkyl Halide Maleimide Pyridyl disulfides, 5-thio-2-nitrobenzoic acid	Thioether Thioether Thioether Thioether Thioether Mixed disulfides

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Notably, nanoparticles can primarily accumulate in solid tumours, taking advantage of a peculiar characteristic of neoplastic tissues, taking into account anti-cancer applications. In reality, tumours need a high supply of oxygen and nutrients to proliferate, so angiogenesis is stimulated to form aberrant vasculature quickly [8]. Indeed, rapid tumour blood vessel development results in epithelial defects that render the tumour vasculature more permeable than normal vasculature. This phenomenon, known as the Enhanced Permeation and Retention (EPR) effect, enables nanoparticles to diffuse more effectively into tumour tissue than normal and to survive and accumulate at the tumour site than small molecules that can diffuse back into the blood stream [9].

However, instead of micro-or sub-micrometric materials (i.e. increased drug solubility and drug therapeutic index, prolonged drug half-life in the target organ and decreased drug immunogenicity), the benefits provided by particles of nano-metric size are somehow limited both by the still poor knowledge of the mechanisms that govern the interactions between nanoparticles and cells/tissues and Consequently, stimulus-responsive nano materials were proposed as advanced delivery systems, designed to show a controllable, dynamic interplay with the transported drug, in order to exert control over the release of drugs, as well as on the accumulation and clearance rates. Figure 1 illustrates the (a) rapidly growing cancer cells, (b) SAMN@RITC-BSAO (c) Core-shell. Figure 2 illustrates the Nanoparticles (a) Schematic illustration of NPs features for anti-cancer activity. Table 1 illustrates the most used functional groups.

CONCLUSION

By applying nano-structures in various fields, especially in medicine and drug delivery systems, the rapid development of nanotechnology has bridged the gap between biological and physical sciences. The combination of nanoscience together with active compounds/biomolecules in particular represents an attractive frontier, particularly in the treatment of cancer. Indeed, for both therapeutic and diagnostic purposes, various nano systems are currently under study to deliver drugs/biomolecules into cancerous cells or tissues. Notably, the use of nano-based drug delivery systems to directly target drugs to the desired position of action may be an achievable alternative that could overcome some of the crucial problems common to traditional therapies. The key advantage of nanoparticles is that they have a higher surface-to-volume ratio compared to micro- or sub-micrometric particles, which can be used to bind high concentrations of either active/targeting biomolecules (i.e. enzymes, DNA, proteins) or chemical compounds (e.g., chemotherapeutic agents, dyes). Remember that these structures are nanosized and easily penetrate the tissues, accumulate in the tumour site (i.e. EPR effect) and promote the drug's cell uptake leading to effective delivery of drugs and action at the desired location. Generally, it is possible to encapsulate therapeutic drugs or biomolecules inside the nanostructure or to bind them to their surface. The most common chemical procedures for obtaining efficient loading of biomolecules on various nano materials have been outlined in this study. To note, on the basis of their scale,

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form, and other physical/chemical features, the effectiveness of nanostructures as drug delivery vehicles and/or diagnostic devices inevitably differs.

REFERENCES

[1] G. Velasco, S. Hernández-Tiedra, D. Dávila, and M. Lorente, "The use of cannabinoids as anticancer agents," *Progress in Neuro-Psychopharmacology and Biological Psychiatry*. 2016, doi: 10.1016/j.pnpbp.2015.05.010.

[2] V. L. Heath and R. Bicknell, "Anticancer strategies involving the vasculature," *Nature Reviews Clinical Oncology*. 2009, doi: 10.1038/nrclinonc.2009.52.

[3] E. N. Kumar and E. S. Kumar, "A Simple and Robust EVH Algorithm for Modern Mobile Heterogeneous Networks- A MATLAB Approach," 2013.

[4] S. Kumar, A. Gupta, and A. Arya, *Triple Frequency S-Shaped Circularly Polarized Microstrip Antenna with Small Frequency-Ratio*. 2016.

[5] D. E. Thurston, *Chemistry and pharmacology of anticancer drugs*. 2006.

[6] T. Tian, S. Olson, J. M. Whitacre, and A. Harding, "The origins of cancer robustness and evolvability," *Integr. Biol.*, 2011, doi: 10.1039/c0ib00046a.

[7] F. A. Scappaticci, "Mechanisms and future directions for angiogenesis-based cancer therapies," *Journal of Clinical Oncology*. 2002, doi: 10.1200/JCO.2002.01.033.

[8] J. Beuth, "Evidence-based complementary oncology: Innovative approaches to optimise standard therapy strategies," 2010.

[9] S. Wesselborg and K. Lauber, "Mechanisms of anticancer drug action," in *Apoptotic Pathways as Targets for Novel Therapies in Cancer and Other Diseases*, 2005.

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