e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:07/Issue:01/January-2025 Impact Factor- 8.187 www.irjmets.com

NANOCOLOGY - REVOLUTIONIZING CANCER DIAGNOSIS THERAPY

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DOI : https://www.doi.org/10.56726/IRJMETS65928

ABSTRACT

Recent advances in nanomedicine have been propelled by innovative technologies, with nanoparticles taking center stage in diagnostic and therapeutic applications. Their nanoscale size imparts unique properties, enabling them to bind, adsorb, and transport biomolecules like DNA, RNA, proteins, and various chemical agents, leading to significant biological effects. Customization of nanoparticles in terms of size, shape, and surface characteristics enhances their functional activity. These particles are known for their high stability, substantial loading capacity, and compatibility with both hydrophilic and hydrophobic compounds. Nanoparticles hold immense potential for revolutionizing drug delivery systems and diagnostic methods, particularly in oncology. This discussion explores the emerging role of nanoparticles as potent antibacterial agents and highlights their applications in cancer diagnosis and monitoring, offering a glimpse into their transformative impact on healthcare.

Keywords: Nanoparticle, Liposomes, Gold Shelled Nanoparticle, Peptide, Small Molecule Target.

I. INTRODUCTION

Currently, cancer prevention and treatment often include surgery, radiation therapy, and chemotherapy. Over the years, there has been an increasing understanding of how oncology research can help develop effective cancer treatment strategies. Cancer is a global problem today because of its prevalence, morbidity, and mortality, as well as its increasing number of people. [1-3]Currently, approximately 10 million people die from cancer each year, and this number is expected to reach 13 million by 2030. However, since normal cells are affected, it can also have negative results [4] and this can lead to various problems. Chemotherapy is considered an aggressive cancer treatment. Therefore, other protein-rich areas such as hair follicles, bone parenchymal cells and intestinal tracts are also affected, causing side effects such as hair loss, nausea, vomiting, weakness, hypoxia and sometimes thirst.

In addition to X-ray treatment, these products are usually very painful. However, it is true that they are rarely treated for various reasons, especially due to the use of drugs and the design of treatment. The birth rate has improved in recent years, but the number of new cancer cases continues to increase worldwide. Therefore, the average quality of the vaccine is too shallow to be produced at home. . With the emergence of cancer nanomedicines, there are also challenges that need to be acknowledged. This review highlights the efficacy of nanomedicine and discusses the application of nanotechnology in healthcare. We describe the role and prospects of nanomedicine in cancer therapy and explain the role of nanoparticles in cancer therapy, especially in therapeutic, anti-angiogenic and disease prevention aspects. Furthermore, current clinical studies have also identified the application of nanoparticle cancer therapy [5-7]. Therefore, there is a need to reduce the frequency of antibiotic use without compromising the overall effectiveness of antibiotic use. Therefore, it is important to introduce new and improved cancer therapies that are safe and effective. In recent years, there have been many developments that will expand cancer treatment options beyond curative treatments. New technologies such as genomic technologies [8] and new methods for protein translation and function have great potential for understanding molecular features and new targets for drug development [9]. This approach can also improve cancer models with the ultimate goal of developing treatment strategies that target tumor heterogeneity, structure, variability and sensitivity to specific therapies [10]. [11] Advances in precision-targeted nanotechnology and smart technologies have revolutionized drug delivery systems, which have been extensively evaluated with in vitro and in vivo efficacy studies, and numerous studies have demonstrated

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their potential. The complexity, composition and utilization of dendrites are being investigated. Sex becomes important. [12] According to the above, the efficiency of NP scanning needs to be modified such as absorption and changes in the target. Various biomolecules have been developed and used in these weapons and these are discussed in detail in [13]

The use of drugs – cancer treatment, immunotherapy, immunotherapy and radiation therapy – aims to suppress the immune system. In order to increase immunity, to enhance immunity, These nanoparticles are programmed in such a way that the drug is only distributed in the presence of biological stimuli and is suitable for innovation where the drug needs to be released at a specific location and at a specific time of conception. Thanks to the advances in nanotechnology, these devices have become indispensable in drug delivery, diagnosis, diagnostic procedures and other therapeutic measures, paving the way for a bright future in medicine. Controlled, targeted delivery systems are also widely used in nanotechnology-based approaches, allowing this process to be used in future drugs and treatments.

II. NANOPARTICLE A CARRIER OR MEDICINE DELIVERY

The operation of nanocarriers in medicine deliveries has further advantages over the normal modes of treatments with respect to solubility improvement of hydrophobic/ hydrosoluble medicines and protection from destruction or inactivation[16]. Similar parcels may lead to better stability than conventional fusions. Also, due to the construction of medicine delivery nanocarriers, strategies are in place to enable the medicine to remain in rotation for a more extended period, enabling better targeting of the medicine to the point of action[17]. Another important point is the provision of drug to the case in lower boluses, thereby minimizing the side goods performing from the medicine or any excipients in the expression. Belly and associates(Time), for case, were suitable to demonstrate that factors that grease both unresistant and active targeting enable nanocarrier accumulation at the asked point of action. Nanocarriers with targeting ligands incorporated within their structure have also been designed by scientists so that these patches can be delivered to specific cells[18] Hence, nanocarriers that deliver medicines efficiently, indeed by their revision, have been coupled with ligands that target specific receptors present or overpresent on apkins of interest, which results in effective medicine delivery while reducing side or systemic toxin[19]

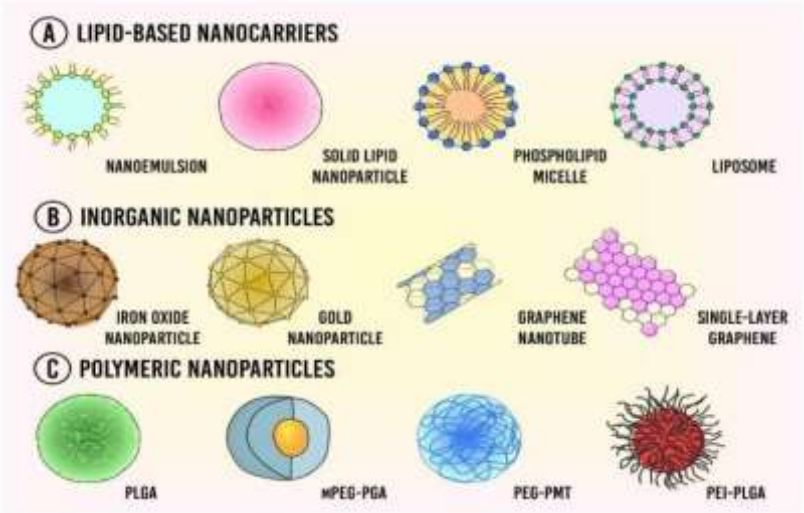

Figure 1: Types of nanocarriers used for medicine delivery in cancer remedy.(A) Lipid- grounded nanocarriers;(B) Inorganic nanoparticles;(C) Polymeric nanoparticles.

Active and unresistant targeting have been used in different degrees in relation to the molecular labels of the applicable pathological processes antedating and accompanying the onset of complaint. Since nanoscale medicine- delivery systems present an advanced approach to convey medicines, multitudinous organic or inorganic nanostructured patches (NPs) have been created[20], the primary end being that of transporting a certain emulsion to its point of action and causing a lesser remedial effect[21].

Crack Targeting Systems advanced features as well as standard bone. earning inventories in bulk from targeted out- schedule Manufacturing sources and extreme cost constraint counting on foreign low- cost services to

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perform analogous scribe tasks in encapsulated software systems Tsuchida D, Yamasaki Y, Ishida K, Shimizu S, Igarashi J, Matsumoto M, Itadani R, Hayashi KI. Active and unresistant approaches also use nanocarriers to deliver pharmacological agents to their specific point of action. Explanation and principles behind active and unresistant point-specific nanocarrier- intermediated medicine delivery. Nicholl C. D. Drug delivery systems Strategies, new trends, and operations.

A. The Nanoparticle-Drug Complex

Nanoparticles, when utilized as carriers, will either adhere the drug to its surface or, to enhance stability or prevent denaturing of the drug, encapsulate the drug inside the carrier. Nanoparticle carriers also provide the opportunity for the co-administration of two or more drugs for use in combination therapy. Moreover, newer approaches have also focused on the use of non-cytotoxic prodrugs, which can be transformed into their active forms after reaching the target cancerous tissues (i.e., once delivered inside cells using nanoparticle carriers, photoreduction of Pt-based chemotherapeutic agents occurs whereby visible light is used to convert the Pt [IV] inactive form of the drug to the active anticancer drug Pt [II]). [35] Several types of nanoparticle systems have been used as carriers, including liposomal, solid lipid, polymeric, mesoporous silica, and inorganic nanoparticles.

A liposome is a bio-based nanocarrier system in the form of self-assembling concentric lipid bilayers consisting mainly of amphiphilic phospholipids with an empty cavity filled with water in the center. They can encapsulate encased hydrophilic drugs in the central water zone within and are also complex systems that, upon endocytosis, can release their drug contents from the membrane upon attaching to cell surfaces. [36]It has also been estimated that liposomal encapsulation enhances the pharmacokinetics and pharmacodynamics of liposome-associated drugs. Over time, liposomes have been altered on their surfaces with glycolipids and/or polyethylene glycol (PEG) in a bid to inhibit the fast removal from the bloodstream by the reticuloendothelial system (RES), mononuclear phagocytic cells.[37]

B. Gold shelled Nanoparticle

Hollow silicon dioxide core-shell gold nanoparticles are called hollow gold nanoparticles. It can be used in cancer treatment and improve blood tests. Drugs can be used in cancer diagnosis and treatment here. Cancer diagnosis can be made with dual detection technology in the treated target area with nanoparticles decorated with shells having a suitable binding region for the target area. [38] Unmanned aerial vehicle systems. Gold nanomaterials are widely used due to their size, quality and ability to control light in surface plasmon crystals. They are claimed to be beneficial for treatment due to their high biocompatibility and distinct sounds, helping to solve simple adhesion problems and problems caused by cancer. Gold nanoshell. People often talk about treating cancer by destroying the body and absorbing plasma markers. According to scattering, imaging of gold-coated nanoparticles is possible only at certain wavelengths given the size and shape of the object and does not produce good images at other wavelengths. In a phenomenon called photothermal ablation, thermal nanoparticles and the heat surrounding them cause nearby cells to die. If nanoparticles are designed to target these activities, antibodies in the form of antisense DNA oligonucleotides that are brought to the tumor site during photostimulation will also be present. Gene therapy is heat and light dependent: heat and light dependent: heat and light dependent. How is this possible? Cancer biology and nanoparticle research on gene therapy and cancer for medical applications "Safety and side effects" Cancer treatment shows that almost anything can happen in cancer. Clinical studies on other types of depression are another example. Learn more about how to treat cancer like cancer. When it comes to molecular medicine, gold nanoparticles are in the picture. Other different themes, Kazakh labyrinth, etc. These are emerging fields and cancer and nanotechnology have created successful and mutually beneficial relationships. Cancer treatment with drugs and nanotechnology. The cornerstone of cancer treatment is plasmids and vaccines. Nanotechnology in Cancer Centers Nanotechnology brings new hope to cancer treatment: the application of nanophysics to cancer treatment. Nanophysical Technology Ultrafast Events Nanotechnology is about understanding and controlling matter with dimensions smaller than 100 nanometers. Nanotechnology: Nanophysics is the study of matter at scales below 100 nanometers. Strange machines that appear frequently in the story: Nanomachines that can exist on a very small scale and move around the body while working. Nanobots! The idea that "nano-scale machines" could move around the human body and perform tasks is a bit surreal. They talked about "the concept of amazing machines where molecules and atoms work together to create unique and useful systems for the body." [44] For example,

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oxygen production is just one of many "types" and CLHG-antibiotics. Many other capabilities have been developed and researched. Materials - A comprehensive review of the production of siderophores from different ores and non-ferrous metal sources and the application of this knowledge to the implementation of chemical safety protocols. Research should continue on the development and use of oxygen-containing metals in chemistry.

C. Liposome-

A liposome is described as the closed type of structure made in the form of a spherical lipid bilayer that creates an internal cavity that can contain an aqueous solution [46]Besides, as a common system of administered medication, liposomes are capable of being filled with powders and biological agents regardless of the size and the water solubility of the said powders in order to shield them from destruction or dilution while in the vascular system. [47]After the release of Doxil® in 1995, a number of the liposome drug products, Ambisome® and Vyxeos®, have been introduced since then. [48-49]Doxil® has been of great importance during the course of treatment of cancers, fungal infections, and for pain management, among other indications when it has been injected intravenously, administered orally, applied transdermally, nasally, or via inhalation, even though they have most likely advanced the cause of drug administration to the limits that obtaining therapeutic or nontoxic drugs, miscible with the bodily fluids, is not a problem.[50] Still, the majority of products available in today's market are in the form of very unstable saline liposomal dispersions. Both of these PCL-based liposomes could be destabilized by permeation of the outer phospholipid membrane via injected drugs, typically during a drug delivery compaction process damage to the phospholipid bilayer resulting from chemical attacks, such as phospholipid oxidation or hydrolysis, and also phase separation or concentration induced by environmental conditions, such as heat or cold.[51]

The increase in bilayer permeability, vesicle aggregation, fusion, or precipitation with concurrent drug leakage will cause degradation of liposome biological function and decrease product shelf life, which restricts the extensive usage of liposomes.[52]

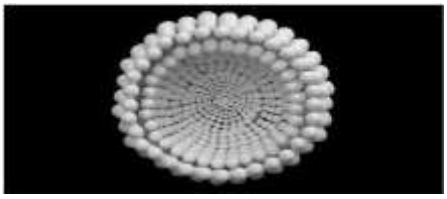

Figure 2: Model of normal liposome

III. THE STABILITY OF THE NANOPARTICLE DRUG COMPLEX

When drug-loaded nanoparticles are present in the blood The relationship between the radial and axial dimensions of the cricoid time is always taken into account during the expansion or change of body tissues. Nanoparticles smaller than 500 nm are generally removed by the kidneys, while nanoparticles larger than 500 nm are removed by macrophages. [53-54]RE systems capture nanoparticles, reducing their efficacy and presence in the peripheral circulation. However, surface modification by hydrophilic PEG chains can give nanoparticles "stealth" properties, thus reducing their immunogenicity and preventing the recognition and phagocytosis of insect messages from the mononuclear phagocyte system, thus prolonging their residence time. As can be seen, if "naked" nanoparticles are used, they continue to interact with proteins, causing their accumulation in biological cells.[55] PEGylation of nanoparticles provides a biolayer that increases the structural stability of nanoparticles and reduces the risk of protein adsorption and aggregation. This disrupts the aggregation of nanoparticles in solution, preventing them from coalescing as they enter blood vessels, which can gel and curdle blood, causing small infarctions in other areas and internal organs.[53]

IV. NANOTECHNOLOGY IN CANCER DIAGNOSIS

According to GLOBAL 2018 estimates, the number of new cancer cases will approximate 18.1 million, while the total number of deaths from cancer will be 9.6 million [56-57] It has been projected that by the year 2030, 30 million people will be dying from cancer per year [57]In the battle of cancer, treating the patients at the earliest stage plays a crucial role in the successful treatment of cancer. Cancer nexus death is significantly reduced by

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early diagnosis as well [57]. For instance, the 5-year relative survival rate for breast cancer attains almost 90% at the local stage, yet the same patients with distant metastasis only have a 27% 5-year survival [58].Currently, diagnostic imaging methods, cell (cytology) or tissue (histopathology) morphological assessment helps to diagnose several types of cancers at their early stages. The most commonly used imaging techniques, X- ray, magnetic resonance imaging (MRI), computed tomography (CT), endoscopy, and ultrasound, mainly visualize internal structure changes, allowing cancer detection only when tissue alteration is already evident [59]. Metastasis and colonization of other tissues by cancer stem cells may have already occurred at that point. Furthermore, the limitation is that current imaging techniques can only identify the presence or absence of cancer without being able to tell if these are infiltrating benign or malignant tumors [60].

In addition, the application of procedures based on the principles of cytology and histopathology has not been able to work optimally and independently in aiding in the detection of early cancer [61]. There comes the QUITO treatment, where advances in medical imaging eliminate the necessity of treatment and overcome the challenge.

Despite the fact that nanotechnology has never been used for cancer diagnosis in clinical practice, it is, however, already used widely in invasive medical diagnostics, such as in a pregnancy testing kit where gold nanoparticles are mixed in [62]. In cancer diagnosis, nanoparticles are being used for capturing cancer-associated biomarkers like the circulation of proteins related to cancer, circulating tumor DNA, circulating tumor cells, and twosomes [63]. A noteworthy benefit of using nanoparticles in oncological applications is the fact that they have a larger surface area to volume ratio than bulk materials [64]. Thanks to this feature, the surfaces of nanoparticles can be fitted with many antibodies, small organic molecules, peptide chains, tamers, or other similar substances. These substances can attach and identify certain cancer-related biomolecules [65]. When various binding ligands are given to cancer cells, multiple effects are possible, which can enhance the specificity and sensitivity of the assay [65].

Diagnostic methods based on nanotechnology have begun the stage of research and development because of their potential as fast, easy, and economical means of cancer diagnosis and detection [66].

V. NANOTECHNOLOGY IN CANCER TREATMENT

Nanotechnology (the engineering and fabrication of materials using atomic and molecular components) should benefit all branches of medicine, with oncology being by far the most important beneficiary [68-69] National Nanotechnology Initiative Nanotechnology Refers to structures with dimensions ranging from 1 to 100 nm, having at least one dimension. In this dimension, the cross-sections of small molecules, bacteria, viruses, and human hair are approximately 1 nanometer, 100 nanometer, 1,000 nanometer, and 100,000 nanometer, respectively. Nanotechnology generally refers to structures with dimensions up to hundreds of nanometers, and is constructed by top-down or bottom-up engineering (i.e., structural design) of a product Br>[1, 3 → 5].

The resulting nanomaterials may have functional properties guaranteed by the precise assembly of individual particles rather than each particle alone. Nanomaterials have a relatively large surface area, and their physical and chemical properties (such as friction and interactions with other molecules) differ from their larger counterparts.

The most common use of nanotechnology in medicine is to develop new technologies and measurement methods that can go beyond current technology in these areas. With the proliferation of new nanotechnology platforms for life science applications, the potential of nanotechnology in medicine continues to extend far beyond its initial applications.

The National Cancer Institute's $144 million commitment in 2004 to develop new nanotechnologies to reduce the number of cancer patients is defining the path for cancer treatment Particles, dendrimers, nanoshells, liposomes, nucleic acid nanoparticles, magnetic nanoparticles and viral nanoparticles [68].

Nanocarriers have the potential to improve the therapeutic index of existing drugs by increasing drug efficacy, reducing drug toxicity and achieving therapeutic effects over a longer period of time. By improving drug solubility and drug stability, nanocarriers may allow the development of new effective drugs that were blocked during clinical or clinical trials due to Pharmacokinetics or suboptimal Biochemistry properties. Finally, nanocarriers may also contribute to the development of targeted drugs [73-74], combinations [75] or various

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Volume:07/Issue:01/January-2025 Impact Factor- 8.187 www.irjmets.com

systems for simultaneous clinical and diagnostic use.

The development of the first nanocarriers dates back to approximately 40 years ago, when the first examples of liposomes were described [76-77].

More than 20 years ago, many nanoscale carriers with special physical and biochemical properties for drug delivery emerged. Recently, awareness of cancer nanotechnology has increased with several examples of first-generation nanocarriers approved by the FDA for clinical use (Abraxane [78], Doxil [79], DaunoXome [80]) and diagnostic (Feridex [81]) applications (Table 1)

Nanoparticle platforms for drug delivery

Nanoparticle Material Structure
• Polymeric
1. Poly(lactide-co-glycolide)
2. Poly(lactide)
3. Poly(caprolactone)
4. Poly(orthoester)
5. Poly(anhydride)
6. Poly(beta-aminoester)
• Liposome
Doxil®/Caelyx®:
PEG-DSPE:HSPC/Cholesterol(5:56:39)
DaunoXome®:DSPC/Cholesterol (2:1)
• DendrimerBranched
1. Poly(amidoamine)
2. Poly(ethylenimine)
3. Poly(peptide)

Delivery of Nanocarrier Targets to Tumors

The vascularity of tumors is highly heterogeneous, ranging from areas of vascular necrosis to areas of dense blood vessels

To maintain sufficient oxygen

To provide nutrients for growth in cancer. Compared with normal blood vessels, tumor blood vessels have many abnormalities, including a high rate of proliferating endothelial cells and abnormal basement membrane

, increased blood vessel tortuosity, and defective vascular efficiency [81]. Cancer microvessels exhibit increased permeability, which is partially regulated by abnormal vascular endothelial growth factor, pectoralis dynamin, nitric oxide, prostaglandins, and matrix metalloproteinases [81].

The transport of macromolecules along the tumor microvasculature may occur through the opening of interendothelial junctions or transendothelial channels. In many models, pore cutoff sizes for transport are estimated to be in the range of ~1 μm, and xenografts measuring lipid extravasation into tumors in vivo show similar sizes in the 400nm range [83] 83-84] a. The lymphatic system is also abnormal, resulting in fluid retention in the lymph nodes, high tissue pressure, and fluid outflow from the tissue

[85].

Peptides

Studying the target using antibodies

Allows people to better understand the fundamental factors that affect the target. Peptides and antibodies have been developed to address some of the negative aspects of antibodies, and many examples of these ligands are

now in clinical use. It is now generally accepted that the affinity, stability and size of the ligand play an important role in target acquisition. Peptides are small electronic products that can be produced in large quantities with great control. Peptides are more stable than antibodies and less immunogenic. Due to the development of peptide library screening methods (such as phage display; 1011 different peptides), new peptide targeting sites have been successfully discovered [86-87-88]. Plant technology is a powerful tool for isolating new ligands for clinical and diagnostic applications. Twenty-five years ago, Scott and Smith reported the first peptide phage library [89]. Combinatorial peptide libraries are characterized by a number of different variants or are based on mutated backbones. In general, cyclic stable or multivalent peptides show greater affinity due to improved rigidity and interactions with cell membrane antigens.Generally, short peptides are selected after library affinity evaluation of target proteins, whole cells, isolated tissues or living animals, and even humans [87,91–93].

Small Molecule Targeting

In general, small molecules are very attractive as targeting ligands because they are relatively inexpensive and easy to incorporate into drugs, such as imaging probes (quantum dots, etc.) and nanoparticles [94-95] a. The small size of the targeting ligand allows for the functionalization of many molecules on single nanoparticles. Folic acid and sugar molecules are widely used in this. The vitamin folate is essential for cell survival and folate receptors are overexpressed in cancer cells [96-97]. Folate receptors (FRs) interact with high-affinity folate conjugates and transport the conjugates via receptor-mediated endocytosis before they are recycled back into the cell [98]. Therefore, it is not surprising that folate-targeted nanoparticles have been shown to be effective in many tumors using liposomes [99-100- 110]] or mixed nanosystems [111-112]. However, immunological studies have shown an overabundance of folate receptors in tissues such as placenta and kidney. This poses some problems in the clinical translation of folic acid bioconjugates. In addition, folate-targeted stealth nanoparticles should be carefully designed to avoid the adverse effects of the free PEG chain. Ideally, folate ligands should be used to enhance the binding of folate bioconjugates [113]. Cell surface lectins have been shown to be overexpressed in many cancer cells [114-115] and to internalize glycoconjugates via a receptor-mediated endocytosis mechanism.

The presence of cell membrane lectins that recognize sugar molecules (lactose, galactose, mannose) is an expression of transport or photosensitization. However, to compensate for the poor binding affinity of carbohydrates, multiple or multivalent molecules need to be conjugated to nanocarriers. The targeting efficiency of galactosylated macromolecular carriers has been shown to be dependent on the galactose ligand concentration [116]. Additionally, conjugation of galactoside residues with N-(2- hydroxypropyl) methacrylamide copolymer (HPMA) resulted in increased granulocyte expression in three tumor cell lines [117]

VI. THE CHALLENGES OF NANONCOLOGY

In fact, nanobiology has tremendous potential for change. However, it is not difficult to limit medical treatment or use. Therefore, the use of all nanotechnology in cancer diagnosis and treatment will solve the identified problems. Biocompatibility and ToxicityUnexpected interactions:

1. Nanoparticles can interact with biological organisms in unexpected ways, producing toxic or anti-inflammatory effects. For some nanomaterials, biodistribution, degradation and clearance may be affected. These drugs designed for specific purposes can sometimes affect non-cancerous tissue, limiting their therapeutic benefits.
2. Scalability and Manufacturing IssuesCost: Due to the complexity and precision engineering required for nanomaterial production, manufacturing costs are high, limiting affordability. Experimenting with the size, shape and function of the device will be difficult, and reproducibility will be important. Efficacy and safety, thus affecting regulatory and clinical trials.
3. Regulatory and approval issues Lack of established standards: Not all regulations regarding the use of nanomedicine are fully developed, which results in slow approval. Conducting safety and efficacy studies on traditional drugs to prove their value, delaying time to market. Ethics: The use of new technologies, such as gene delivery via nanoparticles, raises ethical issues.[119]

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Volume:07/Issue:01/January-2025 Impact Factor- 8.187 www.irjmets.com

4. The difference makes the production of complete nanotherapeutics almost impossible.
5. Economics and Accessibility High cost: The full costs of developing and interpreting nanotechnology treatments can be prohibitive for patients in low- and middle-income countries. Insurance: Lack of clarity in reimbursement policies for nanomedicine treatments has an impact on their application.
6. Stability and StorageEnvironmental conditions (pH, temperature or humidity) can affect performance by making nanoparticles unstable. One of the biggest challenges is storing nanomedicines for longer periods without affecting their properties.[120] Hypoxia may limit the effectiveness of some nanoparticle treatments, such as photodynamic therapy for tumors.
7. Public Opinion and Ethical IssuesMyths about nanotechnology will eventually lead to protests from patients and doctors. Concerns about privacy and data security Personal nanomedicines, especially diagnostic tools that use artificial intelligence, are on the rise.[121]
8. Hypoxia may limit the effectiveness of some nanoparticle treatments, such as photodynamic therapy for tumors.

VII. FUTURE DIRECTION

The future and problems of nanotechnology coexist. On the one hand, the economy is expected to grow further in the coming years due to many factors such as advances in technology, more government support, more private financing, and increased demand for small household appliances. Instead, health and environmental hazards associated with its use, safety concerns, and concerns about the importance of nanotechnology in the market will limit its progress. Nanomedicine is a new scientific field that is gaining interest and research. Nanomedicine holds great promise in the diagnosis and treatment of malignant tumors. Specially designed nanoparticles can be used as a different agent in cancer diagnosis and can provide high sensitivity and high resolution for tumor diagnosis by imaging. Nanoprobes and nanobiosensors also offer new options for tumor collection and detection. Appropriate design and production of nanomedicines can enable drug delivery for cancer treatment. Nanoparticles can successfully deliver drugs or genes to cancer cells in a non- functional or targeted approach to improve treatment and minimize damage to healthy tissue. Nanoparticles can also be used for radiosensitization and photothermal therapy to improve the effect of malignant tumors.[122]

VIII. CONCLUSION

Bioscience is a major advancement in the development of cancer diagnosis and treatment by using the unique properties of nanomaterials to overcome the limitations of oncology. Early detection of sensitive biosensors and imaging monitors increases the accuracy of diagnosis, allowing for timely intervention. In medicine, nanoparticle-based drug delivery systems enable precise targeting of tumor cells, reducing the number of adverse reactions and toxicity. These innovations not only improve treatment, but also improve the quality of life of patients by reducing the side effects commonly associated with cancer treatment. Here are examples of the many aspects of nanotechnology in oncology. This dual-function system allows for instant monitoring of treatment response, paving the way for therapeutic strategies and personalization. Issues such as mass production, regulatory requirements, and the long-term potential of nanomaterials for human health and the environment need to be addressed. To overcome these challenges and ensure the safe and effective integration of nanotechnology into oncology, collaboration between scientists, clinicians, and policymakers is essential. It is a cutting-edge field with the potential to revolutionize diagnosis and treatment. As technology is used and problems are solved, the future vision of cancer management towards more accurate, efficient, and patient care is also worsening.

ACKNOWLEDGEMENT

We would take the opportunity to thank "The Almighty God" And my "Parents" for providing me with such a wonderful life and making me capable of reaching this position.

We express my sincere thanks to Mr. MANIKARAOJI THAKARE, Honourable chairman, “Nvasanjeevan Shishan Prasarak Mandal’s Darwha”. For providing facilities and an encouraging working atmosphere during the course of my study.

We would like to acknowledge the ever helping, highly eminent and sincerely respectable Dr. AVINASH S.

JIDDEWAR Principal "Nvasanjeevan Shishan Prasarak Mandal's College Of Pharmacy Darwha". And for creating such encouraging atmosphere due to which the review work has been possible.

We would like to heartly and sincerely acknowledge the efforts of my highly esteemed and respectable guide Prof. Mr.Satish D. Dukare their valuable guidance, constant appreciate, inspiration, regular motivation, encouragement and indeed sample interest in the project which enabled me to complete my project.

We are also thankful to my friend and colleagues for their charming company, timely help and co-operation. I am thankful to all juniors and seniors for their direct or indirect help during this report work. I am especially thankful to Librarian and all non-teaching staff member "Nvasanjeevan Shishan Prasarak Mandal's College Of Pharmacy Darwha". For their timely help and caring nature.

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