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NANOTECHNOLOGY-BASED DRUG THERAPY FOR CANCER TREATMENT: OPPORTUNITIES AND CHALLENGES

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ABSTRACT

Cancer remains one of the leading causes of mortalityworldwide,andconventional treatment methods such as chemotherapy, radiation therapy, and surgery often suffer from limitationsincludingpoordrugselectivity,systemictoxicity,multidrugresistance, and severe side effects. Nanotechnology-based drug therapy has emerged as a promising approach to overcome these challenges by enabling targeted and controlled delivery of anticancer agents. Nanocarriers such as liposomes, polymeric nanoparticles, dendrimers, metallic nanoparticles, carbon nanotubes, and micelles enhance drug solubility, bioavailability, therapeutic efficacy, and tumor-specific accumulation through passive and active targeting mechanisms. These nanoscalesystemsalsosupportcombinationtherapy,imaging,andtheranosticapplicationsfor improved cancer diagnosis and treatment monitoring. Despite significant advancements, several challenges remain, including nanoparticle toxicity, biocompatibility issues, stability, large-scale manufacturing, regulatory approval, and long-term safety concerns. This review highlights recent developments in nanotechnology-based cancer drug therapy, discusses various nanocarrier systems and their therapeutic applications, and examines the major opportunities and challenges associated with clinical translation. The study emphasizes the futurepotential ofnanomedicine in developing safer, more effective, and personalized cancer treatment strategies.

KEYWORDS: Nanotechnology, Cancer Therapy, Nanocarriers, Targeted Drug Delivery, Nanomedicine.

I. INTRODUCTION

Cancerisoneofthemostseriousandlife-threateningdiseasesworldwide,characterizedbythe uncontrolledgrowth and spreadofabnormal cells in thebody.Accordingto theWorldHealth Organization, cancer accounts for millions of deaths annually and poses a major burden on healthcare systems across the globe. Conventional cancer treatment methods, including chemotherapy, radiation therapy, and surgery, have significantly improved patient survival rates; however, these therapies often suffer from several limitations such as non-specific targeting,systemictoxicity,severesideeffects,poordrugsolubility,andmultidrugresistance. Thesechallengesreducetherapeuticefficiencyand negativelyaffectthequalityoflifeofcancer patients.

Inrecentyears,nanotechnologyhasemergedasarevolutionaryapproachinthefieldofcancer therapeutics. Nanotechnology-based drugtherapy involves the useofnanoscale materials and carriers,typicallyrangingfrom1to100nanometers,forthetargeteddeliveryofanticancer drugs.Nanocarrierssuchasliposomes,polymericnanoparticles,dendrimers,micelles,metallic nanoparticles,andcarbonnanotubesprovideseveraladvantagesovertraditionaldrugdelivery systems. These include improved drug solubility, enhanced bioavailability, prolonged circulation time, controlled drug release, and selective targeting of tumor tissues. Nanotechnology also enables both passive targeting through the enhanced permeability and retention (EPR) effect and active targeting using ligands, antibodies, or receptors specific to cancer cells.

The application of nanomedicine in cancer treatment has shown promising outcomes in improving therapeutic efficacy while minimizing damage to healthy tissues. Furthermore, nanotechnology supports advanced approaches such as combination therapy, gene delivery, immunotherapy, and theranostics, where diagnosis and treatment are integrated into a single platform. Several nano-formulated anticancer drugs have already received clinical approval, demonstrating the growing importance of nanotechnology in modern oncology.

Despite these advancements, nanotechnology-based cancer therapy still faces multiple challenges. Issues related to nanoparticle toxicity, biocompatibility, immune system interactions, large-scale manufacturing, stability, regulatory approval, and long-term safety remain major concerns for researchers and pharmaceutical industries. In addition, the complexity of tumor biology and variability among patients continue to limit the successful clinical translation of many nanomedicine systems.

This review focuses on the recent advances in nanotechnology-based drug therapy for cancer treatmentanddiscussesthevariousnanocarriersystemsusedinoncology.Italsohighlightsthe major

opportunities, therapeutic benefits, and challenges associated with nanomedicine, emphasizing the need for further research to develop safe, efficient, and personalized cancer treatment strategies in the future.

II. REVIEW OF LITERATURE

R. K. Jain and T. Stylianopoulos discussed the major barriers associated with delivering nanomedicine to solid tumors. The authors explained that abnormal tumor vasculature, high interstitial fluid pressure, and dense extracellular matrices reduce the penetration and distribution of nanoparticles inside tumor tissues. Their study highlighted the importance of improving nanoparticle transport mechanisms to enhance therapeutic efficiency. They also emphasizedthatoptimizationofparticlesize,shape,andsurfacepropertiescanimprovetumor targeting and reduce systemic toxicity. This work provided significant insights into the physiological challenges of nanomedicine-based cancer therapy and suggested strategies for enhancing drug delivery in solid tumors.

Sahoo and Labhasetwar reviewed the application of nanotechnology in drug delivery and medical imaging. The authors explained that nanoparticles can improve drug solubility, bioavailability, and controlled release properties. They discussed various nanocarrier systems such as polymeric nanoparticles, liposomes, dendrimers, and nanoshells for targeted cancer treatment. Their study also highlighted the role of nanotechnology in molecular imaging and diagnosis,enablingsimultaneousdetectionandtherapyofcancer.Thepaperdemonstratedthat nanotechnology could significantly reduce adverse side effects associated with conventional chemotherapy while improving treatment efficiency.

0Farokhzad and Langer presented the impact of nanotechnology on modern drug delivery systems, especially in cancer therapeutics. The study focused on the development of targeted nanoparticlescapableofdeliveringdrugsdirectlytocancercellswhilesparinghealthytissues. The authors discussed surface-functionalized nanoparticles, ligand-mediated targeting, and controlled drug release mechanisms. They emphasized that nanotechnology has the potential to revolutionize personalized medicine by improving therapeutic outcomes and minimizing toxicity. The paper also addressed the translational challenges associated with clinical implementation of nanoparticle-based therapies.

M. Ferrari explored the opportunities and challenges of cancer nanotechnology in diagnosis and treatment. The study explained that nanoscale devices and drug carriers can improve the precision and effectiveness of cancer therapy. Ferrari discussed the potential applications of nanotechnology in early cancer detection, targeted drug delivery, imaging, and minimally

invasivetreatments.However,thepaperalsohighlightedseverallimitations,includingtoxicity concerns, biological barriers, and manufacturing complexities.This work established astrong foundation for future research in cancer nanomedicine and emphasized the need for interdisciplinary collaboration.

R. Duncan introduced the concept of polymer therapeutics and discussed their growing importance in cancer treatment. The study explained how polymer-drug conjugates can improve the pharmacokinetic and pharmacodynamic properties of anticancer agents. The author highlighted advantages such as enhanced drug stability, prolonged circulation time, reducedtoxicity,andselectivetumortargetingthroughtheenhancedpermeabilityandretention (EPR) effect. Duncan also discussed the challenges associated with polymer design, biodegradability, and clinical translation. This paper contributed significantly to the development of polymer-based nanomedicine systems.

ParveenandSahooreviewedtheroleofpolymericnanoparticlesincancertherapy.Theauthors explainedthatpolymericnanoparticlesprovidecontrolleddrugrelease,improvedstability,and enhanced accumulation of drugs in tumor tissues. The study discussed different preparation techniques, targeting mechanisms, and applications of biodegradable polymers in anticancer drug delivery. The paper also highlighted the importance of surface modification for active targeting and improved cellular uptake. Their findings demonstrated that polymeric nanoparticles are promising carriers for reducing the side effects of chemotherapy and improving therapeutic efficacy.

MatsumuraandMaedaintroducedtheenhancedpermeabilityandretention(EPR)effect,which became one of the fundamental principles in nanomedicine-based cancer therapy. The study demonstrated that macromolecules and nanoparticles accumulate preferentially in tumor tissues due to leaky tumor vasculature and poor lymphatic drainage. The authors used the antitumor agent smancs to validate this concept in cancer chemotherapy. Their findings provided the scientific basis for passive targeting strategies used in modern nanoparticle drug delivery systems and greatly influenced the development of tumor-targeted nanocarriers.

PetrosandDeSimonediscussedadvancedstrategiesfordesigningnanoparticlesfortherapeutic applications.Theauthorsemphasizedtheimportanceofcontrollingparticlesize,shape,surface chemistry,andbiodegradabilitytoachieveeffectivedrugdelivery.Thestudyreviewedvarious fabrication techniques and highlighted the role of multifunctional nanoparticles in targeted therapyandimaging.Theyalsodiscussedbiologicalinteractionsbetweennanoparticlesand

cells, including cellular uptake and immune responses. The paper concluded that rational nanoparticle design is essential for improving safety and therapeutic performance in cancer treatment.

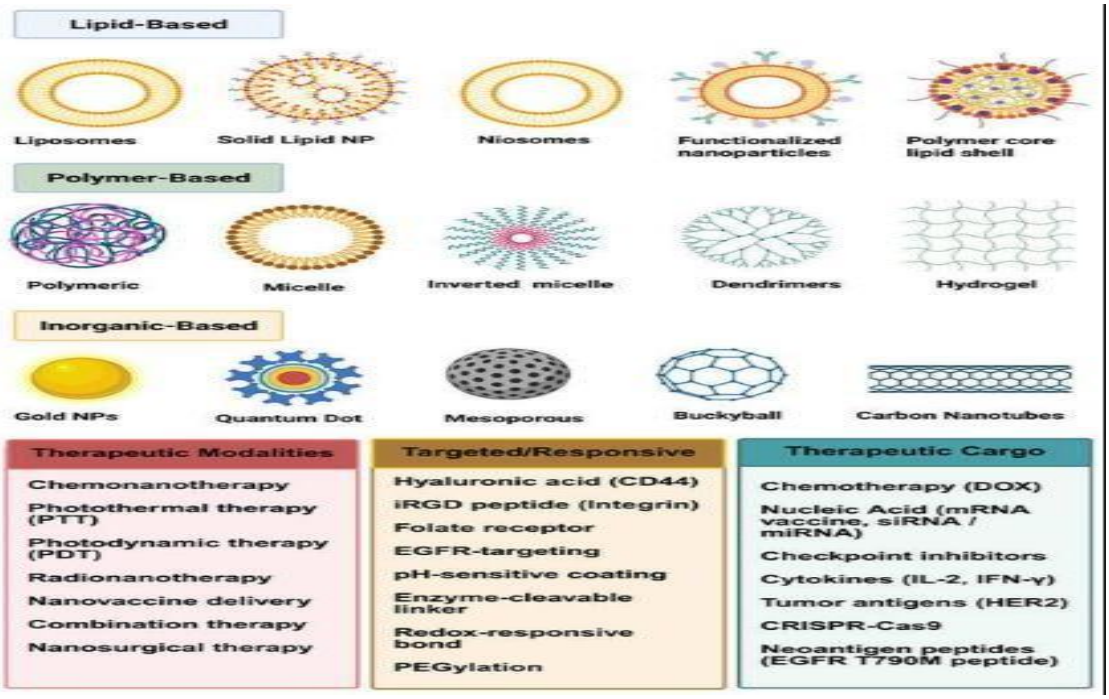
Mura, Nicolas, and Couvreur reviewed stimuli-responsive nanocarriers for drug delivery applications. The authors explained that these smart nanocarriers can release drugs in response to internal stimuli such as pH, enzymes, temperature, and redox conditions, or external stimuli such as light, ultrasound, and magnetic fields. Their study highlighted the advantages of controlled and site-specific drug release for improving anticancer therapy. The paper also discussed the challenges related to stability, reproducibility, and clinical translation of responsive nanocarrier systems. This work demonstrated the future potential of intelligent drug delivery systems in oncology.

Torchilin reviewed recent advances in liposomes as pharmaceutical carriers for drug delivery. The study explained that liposomes are biocompatible vesicular systems capable of encapsulating both hydrophilic and hydrophobic drugs. The author discussed stealth liposomes, PEGylated liposomes, and ligand-targeted liposomes for cancer therapy. The paper highlighted the ability of liposomal formulations to improve drug stability, reduce toxicity, and enhance accumulation in tumor tissues. Torchilin also described clinically approved liposomal anticancer drugs and emphasized the growing importance of liposome-based nanomedicine in targeted cancer treatment.

III. MATERIAL AND METHOD

Materials

The present review study was carried out using published scientific literature related to nanotechnology-based drug therapy for cancer treatment. Various research articles, review papers, books, clinical reports, and online scientific databases were utilized to collect relevant information.



Thereviewfocusedondifferentnanocarriersystemsusedincancertherapy,including:

- Liposomes
- Polymericnanoparticles
- Dendrimers
- Metallic nanoparticles
- Carbon nanotubes
- Micelles
- Quantumdots

Table1: Types of Nano carriers Use din Cancer Therapy.

NanocarrierType	MajorCharacteristics	ApplicationsinCancerTherapy
Liposomes	Biocompatiblelipid vesicles	Targeteddrugdeliveryand reducedtoxicity
Polymeric Nanoparticles	Controlledandsustaineddrug release	Chemotherapyandgene delivery
Dendrimers	Branchednanoscale structures	Drugencapsulationandtargeting
Metallic Nanoparticles	Uniqueopticaland magnetic properties	Imagingandphotothermal therapy
Carbon Nanotubes	Highsurfacearea andstability	Drugtransportandbiosensing
Micelles	Amphiphiliccarriersystems	Deliveryofhydrophobic anticancerdrugs

Method

Step1:Literature Collection

Relevant research papers and review articles published in peer-reviewed journals were collectedfromonlinescientificdatabases.Studiesrelatedtocancernanomedicine,nanoparticle drugdeliverysystems,targetedtherapy,andnanocarrierapplicationswereselectedfor analysis.

Step2:SelectionCriteria

The collected articles were screened based on relevance, publication quality, year of publication, and contribution to nanotechnology-based cancer treatment. Both experimental and review-based studies were included to obtain comprehensive information.

Step3: ClassificationofNanocarriers

Different nanocarrier systems were categorized according to their structure, composition, and therapeutic applications. The major classifications included:

- Organicnanoparticles
- Inorganicnanoparticles
- Lipid-basednanocarriers
- Polymer-basednanocarriers
- Stimuli-responsivenanoparticles

Step4:AnalysisofDrug Delivery Mechanisms

The selected studies were analyzed to understand the mechanisms of targeted drug delivery, including:

- PassivetargetingusingtheEnhancedPermeabilityandRetention(EPR)effect
- Activetargetingusingligands,antibodies,andreceptors
- Controlledandstimuli-responsivedrugrelease mechanisms

Step5:EvaluationofOpportunitiesandChallenges

Thetherapeuticbenefitsandlimitationsofnanotechnology-basedcancertherapywere critically analyzed. Important parameters evaluated included:

- Drug solubility
- Bioavailability
- Tumortargetingefficiency
- Toxicity
- Biocompatibility

- Stability
- Clinicaltranslation challenges

Step6:ComparativeReviewandInterpretation

A comparative analysis of different nanocarrier systems was performed to identify their advantages, disadvantages, and clinical significance in cancer treatment. The findings were interpreted to evaluate the future scope of nanomedicine in oncology.

IV. RESULTS AND DISCUSSION

The present review study analyzed various nanotechnology-based drug delivery systems used in cancer treatment and evaluated their therapeutic efficiency, advantages, and associated challenges. The findings from the reviewed literature indicate that nanomedicine has significantly improved targeted drug delivery and reduced the limitations of conventional chemotherapy.

Different nanocarrier systems such as liposomes, polymeric nanoparticles, dendrimers, micelles,andmetallicnanoparticlesdemonstratedenhanceddrugsolubility,controlledrelease behavior, and improved bioavailability. These nanosystems effectively accumulated in tumor tissues through passive targeting mechanisms based on the Enhanced Permeability and Retention(EPR)effectandactivetargetingstrategiesusingligandsandantibodies.Asaresult, higher therapeutic concentrations of anticancer drugs were achieved at tumor sites while minimizing toxicity to healthy tissues.

Amongthereviewednanocarriers,liposomesandpolymericnanoparticlesshowedthehighest clinical relevancedueto theirbiocompatibility, controlled drugrelease, and reduced systemic sideeffects.Stimuli-responsivenanoparticlesalsodemonstratedpromisingresultsbyreleasing drugsspecificallyinresponsetotumorpH,temperature,orenzymaticconditions.Thistargeted release mechanism improved treatment precision and reduced unnecessary drug exposure to normal cells.

The study also revealed that nanotechnology supports combination therapy and theranostic applications,wherediagnosisandtreatmentcanbeperformedsimultaneously.Severalnano-formulated anticancer drugs have shown improved treatment outcomes in clinical trials compared to traditional drug formulations.

However,despitetheseadvantages,important challengesremain.Toxicityandlong-termsafety concerns associated with nanoparticles continue to limit their clinical translation. In addition, difficulties in large-scale manufacturing, reproducibility, stability, and regulatory approval

createbarriersforcommercialization.Somenanoparticlesmayalsotriggerimmuneresponses or exhibit poor biodegradability, affecting their therapeutic performance.

Overall, the reviewed studies confirmed that nanotechnology-based cancer therapy offers significant improvements in targeted drug delivery and treatment efficiency. Continuous research is required to overcome existing limitations and develop safer, more stable, and clinically effective nanomedicine systems for future cancer treatment.

Table2:ComparativeAnalysisofNanocarrierSystemsinCancerTherapy.

Nanocarrier System	Advantages	Limitations	MajorApplications
Liposomes	Biocompatibleand reducedtoxicity	Stability issues	Chemotherapyand targeteddelivery
Polymeric Nanoparticles	Controlleddrug release	Complexpreparation methods	Sustainedanticancer therapy
Dendrimers	Highdrug loading capacity	Possible cytotoxicity	Geneanddrug delivery
Metallic Nanoparticles	Imagingand photothermaleffects	Long-termtoxicity concerns	Cancerimagingand therapy
Micelles	Improvedsolubilityof drugs	Limited stabilityin blood circulation	Hydrophobic drug delivery

DISCUSSION

Nanotechnology-based drug therapy has gained significant attention in recent years due to its ability to improve the effectiveness of cancer treatment while reducing the side effects associatedwithconventionalchemotherapy.Thereviewedstudiesdemonstratedthatnanoscale drug delivery systems provide better tumor targeting, enhanced drug solubility, controlled release, and improved bioavailability compared to traditional therapeutic approaches. These advantages make nanomedicine an important advancement in modern oncology.

One of the major findings from the reviewed literature is the importance of targeted drug delivery.Conventionalanticancerdrugsoften affectbothcancerousandhealthycells,leading to severe side effects such as hair loss, nausea, immune suppression, and organ toxicity. Nanocarriers such as liposomes, polymeric nanoparticles, dendrimers, and micelles help in selectivelydeliveringdrugstotumortissuesthroughpassiveandactivetargetingmechanisms. TheEnhancedPermeabilityandRetention(EPR)effectplaysavitalroleinpassivetargeting byallowingnanoparticlestoaccumulateintumorregionsduetoleakybloodvesselsandpoor lymphatic drainage.

The studies also revealed that polymeric nanoparticles and liposomal formulations areamong themost successfulnanocarriersystemsbecauseoftheirbiocompatibilityandcontrolleddrug

releaseproperties.Thesesystemsimprovethecirculationtimeofdrugsinthebloodstreamand protect therapeutic agents from premature degradation. Stimuli-responsive nanoparticles further enhance treatment precision by releasing drugs only under specific tumor conditions such as acidic pH, temperature changes, or enzyme activity.

Another important observation is the growing application of nanotechnology in theranostics, where diagnosis and therapy are combined into a single platform. Metallic nanoparticles and quantum dots have shown potential in cancer imaging, early detection, and monitoring treatment responses. This multifunctional capability increases the efficiency of personalized cancer treatment and supports precision medicine approaches.

Despite these advancements, the discussion also highlights several limitations and challenges associatedwithnanotechnology-basedcancertherapy.Toxicityandlong-termsafetyconcerns remain major obstacles to clinical application. Some nanoparticles may accumulate in organs suchastheliver,kidneys,orspleen,potentiallycausingharmfulbiologicaleffects.Inaddition, large-scalemanufacturing,reproducibility,andregulatoryapprovalprocessesarecomplexand time-consuming.

The reviewed studies suggest that future research should focus on improving nanoparticle biocompatibility, reducing toxicity, enhancing targeting accuracy, and developing cost-effective production methods. Integration of artificial intelligence, gene therapy, and personalized medicine with nanotechnology may further improve cancer treatment outcomes in the future.

Overall, nanotechnology-based drug therapy represents a promising and rapidly developing field in cancer treatment. Although several challenges remain, continuous advancements in nanomedicine are expected to contribute significantly to safer, more efficient, and highly targeted cancer therapies with improved patient survival and quality of life.

V. CONCLUSION

Nanotechnology-based drug therapy has emerged as a highly promising approach for improving cancer treatment by overcoming many limitations associated with conventional chemotherapy and radiation therapy. The use of nanocarriers such as liposomes, polymeric nanoparticles, dendrimers, micelles, and metallic nanoparticles has significantly enhanced targeted drug delivery, drug solubility, bioavailability, and controlled release mechanisms. These advanced nanosystems help in selectively delivering anticancer drugs to tumor tissues whileminimizingdamagetohealthycells,therebyreducingsystemictoxicityandadverseside effects.

The review highlighted that nanotechnology provides several opportunities in modern oncology, including personalized medicine, combination therapy, theranostics, and stimuli-responsive drug delivery systems. The enhanced permeability and retention (EPR) effect and activetargetingstrategieshaveplayedanimportantroleinimprovingtherapeuticefficiency and tumor-specific accumulation of drugs. In addition, recent advancements in nanomedicine have supported innovations in cancer diagnosis, imaging, and treatment monitoring.

Despite these significant developments, several challenges still limit the widespread clinical application of nanotechnology in cancer therapy. Issues related to nanoparticle toxicity, biocompatibility,immuneresponses,stability,large-scalemanufacturing,regulatoryapproval, and long-term safety remain major concerns. Furthermore, the complexity of tumor biology and variability among patients make the development of universally effective nanocarrier systems difficult.

Overall,nanotechnologyhasthepotentialtorevolutionizecancertreatmentbyprovidingsafer, more efficient, and targeted therapeutic approaches. Continued research and interdisciplinary collaborationarenecessarytoaddress existingchallengesandimprovethe clinicaltranslation of nanomedicine. Future advancements in nanotechnology-based drug delivery systems are expected to contribute significantly to the development of effective and personalized cancer therapies with improved patient outcomes.

REFERENCES

1. R. K. Jain and T. Stylianopoulos, “Delivering nanomedicine to solid tumors,” *Nature Reviews Clinical Oncology*, vol. 7, no. 11, pp. 653–664, 2010.
2. S. K. Sahoo and V. Labhasetwar, “Nanotech approaches to drug delivery and imaging,” *Drug Discovery Today*, vol. 8, no. 24, pp. 1112–1120, 2003.
3. O.C.FarokhzadandR.Langer,“Impactofnanotechnologyondrugdelivery,”*ACSNano*, vol. 3, no. 1, pp. 16–20, 2009.
4. M. Ferrari, “Cancer nanotechnology: Opportunities and challenges,” *Nature Reviews Cancer*, vol. 5, no. 3, pp. 161–171, 2005.
5. R.Duncan,“Thedawningeraofpolymertherapeutics,”*NatureReviewsDrugDiscovery*, vol. 2, no. 5, pp. 347–360, 2003.
6. S.ParveenandS.K.Sahoo,“Polymericnanoparticlesforcancertherapy,”*JournalofDrug Targeting*, vol. 16, no. 2, pp. 108–123, 2008.
7. Y.Matsumura and H.Maeda, “Anewconcept for macromoleculartherapeuticsin cancer chemotherapy: Mechanism of tumoritropic accumulation of proteins and the antitumor

agent smancs," *Cancer Research*, vol. 46, no. 12, pp. 6387–6392, 1986.

8. R.A.PetrosandJ.M.DeSimone,"Strategiesinthedesignofnanoparticlesfortherapeutic applications," *Nature Reviews Drug Discovery*, vol. 9, no. 8, pp. 615–627, 2010.
9. S.Mura,J.Nicolas,andP.Couvreur,"Stimuli-responsivenanocarriersfordrugdelivery," *Nature Materials*, vol. 12, no. 11, pp. 991–1003, 2013.
10. V. P. Torchilin, "Recent advances with liposomes as pharmaceutical carriers," *Nature Reviews Drug Discovery*, vol. 4, no. 2, pp. 145–160, 2005.
11. H. Maeda, "Toward a full understanding of the EPR effect in primary and metastatic tumors," *Journal of Controlled Release*, vol. 156, no. 3, pp. 277–279, 2011.
12. P.Kesharwani,K.Jain,andN.K.Jain,"Dendrimerasnanocarrierfordrugdelivery,"
13. *ProgressinPolymerScience*,vol.39,no.2,pp.268–307, 2014.
14. S. Biswas and P. Kumari, "Nanotechnology in cancer drug delivery and selective targeting," *ISRN Nanotechnology*, vol. 2012, pp. 1–12, 2012.
15. A. Z. Wang, R. Langer, and O. C. Farokhzad, "Nanoparticle delivery of cancer drugs," *Annual Review of Medicine*, vol. 63, pp. 185–198, 2012.
16. M.E.Davis,Z.Chen,andD.M.Shin,"Nanoparticletherapeutics:Anemergingtreatment modality for cancer," *Nature Reviews Drug Discovery*, vol. 7, no. 9, pp. 771–782, 2008.
17. S.Peer,J.M.Karp,S.Hong,O.C.Farokhzad,R.Margalit,andR.Langer,"Nanocarriers as an emerging platform for cancer therapy," *Nature Nanotechnology*, vol. 2, no. 12, pp. 751–760, 2007.
18. A. Bae and K. Park, "Targeted drug delivery to tumors: Myths, reality and possibility," *Journal of Controlled Release*, vol. 153, no. 3, pp. 198–205, 2011.
19. C. C. Berry and A. S. G. Curtis, "Functionalisation of magnetic nanoparticles for applications in biomedicine," *Journal of Physics D:Applied Physics*, vol. 36, no. 13, pp. R198–R206, 2003.
20. N. Bertrand and J. C. Leroux, "The journey of a drug-carrying nanoparticle in the body," *Journal of Controlled Release*, vol. 161, no. 2, pp. 152–163, 2012.
21. H.Ali, M.Ahmad, and F.Ali, "Recent advances in nanotechnology-based targeted drug deliverysystemsforcancertherapy,"*InternationalJournalofNanomedicine*,vol.17,pp. 1–20, 2022.