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Analysis of Innovative Drug Therapies via Nanotechnologies against HIV/AIDS: A Clinical Systematic Review

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Abstract

HIV/AIDS has become one of the key medical concerns as the infection due to the retroviridae family is not completely curable till now. However, the treatment band effectiveness of drug therapy has improved due to the research and investigation on nanoparticle technology. It has been identified that effective antiretroviral (ARV) delivery is possible with the help of a "nanodimensional carrier system". The article has shed light on the ART and nanoparticle delivery system. Besides this, the utilisation of nanotechnology in antiviral drug and drug therapy has been assessed in this study to identify the future scope of nanotechnology in HIV drug therapy and treatments.

Index Terms

AIDS, ART, ARV, CYP Substance, Drug Therapy, HIV, Nanoparticles, Nanotechnology, PLGA

INTRODUCTION

The article will point out the importance of nanotechnology-based drug therapies used for treating "***Human immunodeficiency virus infection and acquired immune deficiency syndrome***" (HIV/AIDS) that belongs to the ***Retroviridae family***. The nanotechnology-based interventions have been understood through nanocarriers as the delivery of antiretroviral drugs has shown different types of advantages, which includes reduction of side effects and also undesirable interaction of drugs, sustained drug release, and others [1]. Antiretroviral delivery is possible through "***nanodimensional carrier systems***". Free HIV possesses a propensity of undergoing frequent mutations. This type of mutation has the potential to cause altercation within nature and also confirmation within "***Envelope Glycoprotein***" (gp120) (found upon the surface of the envelope of HIV). Thus, it is easy to target infected cells rather than free HIV. The important nanotechnology-based systems are explored through different HIV therapeutics which include nanoparticles, polymeric micelles, liposomes and others that will be discussed throughout the article. The main aim of the article is to understand and evaluate those innovative nanotechnologies-based drug therapies for HIV/AIDS in a qualitative way.

Nanotechnology combines both science and technology for designing and producing systems and devices through manipulation of atoms and molecules considered in terms of a nanoscale [2]. Therapeutic interventions provided through nanotechnology have emerged in the form of multidisciplinary fields where nanocarriers tend to shield the drugs from certain delirious interactions with non-target cells and also biological systems. AIDS has been caused by HIV and is considered to be a global pandemic that has eventually affected morbidity and mortality rates in developing and developed countries [3]. In this respect, "***Antiretroviral***" (ARV) therapy has somehow enhanced the lifespan of people; however, this therapy has increased the mortality rates in some of the developing countries hence its effect is assumed to be worse. The ARV is primarily recommended to every patient except in some cases where the cell count of "***CD4 T lymphocyte***" (CD4) is looked into. The adverse effects of ART are certain diseases such as ***diabetes***, "***atherosclerotic cardiovascular disease***", ***bone loss, weight gain*** and others [3]. HIV medicines have been causing side effects among people where it has been witnessed that some of the side effects have been manageable; however, there are a few grave side-effects.

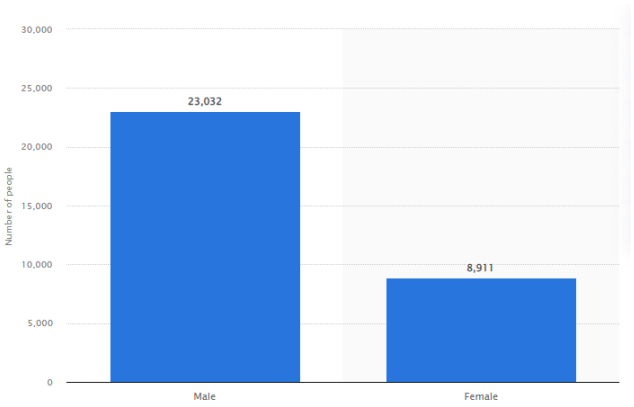

Figure 1: Annual deaths through AIDS among males and females in India in 2020 [4]

Some manageable side-effects from HIV are ***trouble sleeping, fatigue*** and others while severe side-effects are ***high cholesterol*** that further increases the risk of heart attacks among people suffering from AIDS. HIV eradication

is assumed to be an impossible task due to its viral latency in the form of reservoirs and virus sequestration within some privileged organs such as ***liver, kidney, brain, lymphoid tissue***, and others. The above graph is evidence to show that around 23 thousand males have died of AIDS while around ***89 thousand females*** have died of the same disease. 74% of the males have been estimated to have died out of this disease therefore, the death rate from the disease has increased among males as compared with females in a developing country such as India in 2020 [4]. Therefore, it has been proven that mortality rates in developing countries, maybe due to ART therapy, have been worse, unlike the condition in developed countries.

METHODOLOGY

The article has derived relevant information from secondary sources such as journal articles, websites and others where only qualitative information has been collected over quantitative information. It can be better specified that only non-numeric information from available journal articles has been used where information related to clinical studies has been incorporated within the discussion. In this regard, nanotechnology has helped in formulating various systems of drug therapy that include ***nanosuspensions, nano micelles*** and also ***nanoemulsions*** that have proved to improve the therapeutic impacts of several medications. ***Nanosuspensions*** of around 200 nm within ***medication rilpivirine*** (TMC278) have been stabilised through "***polyethylene-polypropylene glycol***" (poloxamer 338) along with "***PEGylated tocopheryl succinate ester***" (TPGS 1000) that have been examined on dogs and mice based on polymeric systems [5]. In comparison with a half-life of over 38 hours in terms of free medication, a specific dosage of administered drugs in respect of nanosuspensions subsequently causes sustained release in 3 months within dogs and also in 3 weeks within mice [5].

This experiment has somehow proved that the delivery through nanoscale medication possesses the potential to curb down the dosage frequency along with boost adherence. Therefore, the other information from different secondary sources will be discussed below to understand the development of nanotechnology-based drug therapies for treating AIDS. Nanosuspensions are assumed to be a dispersion of colloidal drug particles that are biphaspic and have been stabilised with the help of surfactants. Some recent studies have offered an observation on the above experiment where it has been stated it is possible to stabilise "***drug indinavir's nanosuspension***" through a surfactant system prepared from Lipoid E80 in respect of equal distribution in the tissues [5]. An absorption rate of indinavir nanosuspensions has been determined after it has been injected within the macrophages.

The mice have been intravenously injected through macrophage that is seen to be loaded with indinavir nanosuspensions that have been causing a distribution in spleen, liver and other organs. The intravenous delivery from a specific dosage of "***nanoparticle-loaded macrophages***" produced drug levels within the blood for around 14 days in the aftermath of treatment within "***rodent mouse model***" consisting of brain infection from HIV. The drug therapy has subsequently led to antiviral activity within the brain [5]. It has been further assumed that "***vivo nanoparticle-targeted medication delivery***" towards the brain may possess certain benefits where macrophages seem to be applied to target the area of pharmaceuticals within the brain. "Antiretroviral drug delivery" has been utilised in the form of targeting techniques where there are different types of receptors such as "formyl peptide", "galactose", "Fc receptors", "mannose" and others have been witnessed to present over the macrophage's surface.

These receptors have been utilised as "***receptor-mediated internalisatio***n" where "medication stavudine" have encapsulated through different liposomes that have been coupled through mannose and also through galactose that reaches the liver, spleen and other organs [. The targeted liposomes have been assumed to offer cellular absorption as well as prolonged-release within the tissues that indicate an improvement to a certain extent for the free medication. The experiment has been successful where it has been seen that liposomes have been effective in providing drug therapy as part of the innovative approaches through nanotechnology [5]. Zidovudin is an essential medication that has been provided within 1 hour and half-life and possesses limitation in terms of solubility has been derived from "***mannose-targeted liposome***". However, most of the nucleoside medications including "zidovudine" and also "stavudine" have offered serum half-lives that have been assumed to be of therapeutic significance. It has been further estimated that the future will encourage more on the nanotechnology systems that will further focus on enhancing the half-lives to attain certain lessen the frequent dosing.

RESULTS AND DISCUSSION

Result

Systematic review has been carried out to reflect the findings from clinical studies as follows:

Citation	Title of the Article	Findings	Relevance
[6]	"*Biological Aspects and Clinical Applications of Nanoparticles on*	As CD4+ T cells are found to be critical for HIV that has stimulated nanoparticle-based strategies in the form of remedial factors such as "***antiviral***	Nanotechnology has been used in the field of medicine for nanoparticle application

	Treatment and Prophylaxis of HIV"	***siRNA" and "antiretroviral drugs***" CD4+ T cells for the prevention of HIV replication. There are "***lipid nanoparticle***s" aimed at targeting "CD4+T cells" utilising peptides for identifying CD4 co-receptor. The pretreatment through CD4+ T cells while targeting lipid nanoparticles has lessened the number within infected cells in comparison with non-targeted nanoparticles. Conversely, Liposomes (nanomaterial) have been considered to be drug carriers whereas various liposomes have been formulated through "***cardiolipin***" and "***synthetic phospholipids***" through a procedure of ethanol injection. "***Liposomal AAR029b***" has the benefit of increasing medicinal exposure, and enhancing serum half-life that expands "***proteolytic peptide triazoles***" as per the treatment capability of HIV-1 is concerned.	for preventive and therapeutic purposes. Nanotechnology-based systems possess an influence on the systems of drug therapy and also possess the potential to ameliorate the characteristics of the drug. This drug therapy through nanotechnology systems has the power to decrease drug toxicity.
[7]	"*Nanosystems applied to HIV infection: prevention and treatments*"	Delivery agents of "***HIV antigenic peptides***" have been assumed to be cationic Nanocompounds that includes "***G4-70/30 dendrimer***" along with "***β-cyclodextrin derivative AMC6***" for introducing HIV-1 peptides within the "***human dendritic cells***" (DCs). The "***immune-active nanovaccine delivery system***" has the potential to target those DCs that has been further designed through utilising inulin acetate that is assumed to be "***immune-active polymeric material***" (InAc-NPs) that aims to target the TLR4 signaling within the DCs for activation and maturation.	InAc-NPs have shown effective results in the form of producing humoral responses for curing infectious diseases including HIV. Therefore, a nanotechnology approach has offered innovative drug therapy to prevent HIV. However, this drug therapy has been considered to be safe as it does not cause skin toxicity.
[8]	"*Applications of Nanotechnology In Diagnosis and Treatment of Disorders: A Review*"	One of the advancements in nanotechnology has been revolving around "***gold nanoparticles***" (AuNPs) possessing a diameter between 1-100 nm. "Gold nanoparticles" have been considered to be "***biobarcode enhancement examination***" (BCA) which eventually helps in detecting "***HIV-1 p24 antigen***" at its decreased level for offering fast results for HIV/AIDS treatment.	The gold nanoparticles have led to the discovery of "***broad spectrum antiviral drugs***". These antiviral drugs possess the potential for curing different viruses which have been considered to be untreatable.
[9]	"*Novel Approaches in Nanoparticulate Drug Delivery System to Overcome Human Immunodeficiency Virus*"	Various nanoparticulate technologies and methodologies including liposomes, micelles, dendrimers and others have raised interest in AIDS treatment. The drugs that have been encapsulated with liposomes have achieved therapeutic levels in respect of a longer duration. This drug can be balanced through polyethylene glycol (PEG) gatherings associated with "synthetic phospholipids". Dendrimers possess polydispersity while nanometer sizes of those dendrimers provide easier pathway within the biological membranes. Drug therapy through dendrimers delivers the drugs by enclosing	Antiretroviral medicine has been utilised for managing HIV/AIDS where nanotechnology tends to enhance pharmacokinetic properties within those Antiretroviral drugs.

		pharmaceutical ingredient inside of dendrimers.	
[10]	"*Nanomaterials designed for antiviral drug delivery transport across biological barriers*"	Nanotechnology has been utilised in the area of HIV/AIDS development where different ***nanomaterials*** and ***nano architectures*** have been used in the form of HIV vaccine carriers in the wake of proven capabilities to enhance permeability, solubility, and also pharmacokinetics of different earlier HIV vaccines. However, ***nanocarriers have been used in antiviral drugs*** for eradicating HIV reservoirs that have helped in the development of therapeutics as drug therapy to enhance drug effectiveness and curb toxicity.	Namomaterials have been designed of various shapes as well as morphologies that can be used within antiviral therapy where nanometric size permits drug through different impermeable barriers, enhanced efficacy, and others facilitating passage in the cellular membranes.
[11]	"*Nanotechnology approaches for delivery of cytochrome P450 substrates in HIV treatment*"	Nanotechnology development for treatment of HIV can be considered through the preferential size of the "nanoparticles". Nanotechnology has been used in ARVs where formulation of ARVs may control nanoparticles release that will improve half-lives of the people suffering from HIV/AIDS. Nanotechnology can be further utilised in "***CYP substrates***" for HIV treatment in the initial stage.	Antiretroviral drugs (ARVs) have been metabolised through cytochrome P450 (CYP) where most of the drugs have been assumed to be CYP inhibitors and inducers.
[12]	"*Novel Nanotechnology-Based Approaches for Targeting HIV Reservoirs*"	HIV vaccine have been designed through "***lipid-based nanoparticle vaccine platform***" (NVP) presenting "***HIV-1 viral proteins***" for the responses between antigen-specific antibody. "***Liposomes-Based Delivery Systems of Ascorbic Acid***" has the potential to enhance bioavailability of the available ARTs used for treating HIV/AIDS.	The vaccine has the capacity for delivering "protein antigens and adjuvants" that may enhance immunogenicity through promoting the distribution of "protein antigens and adjuvants" towards antigen-presenting cells.
[13]	"*Nanoparticles and its implications in HIV/AIDS therapy*"	Some investigators have utilised "***Poly Lactic-co-Glycolic Acid***" (PLGA) for formulating nanoparticles that have been encapsulated within three ART drugs such "efavirenz", "lopinavir" and others.	The nanoparticle system has been witnessed to have produced a sustained release of the ART drugs for around 4 weeks and on the other hand, free drugs have been removed within 48 hours.

Table 2: Systematic Literature Review (Source: Self-developed)

Discussion

Lipid nanoparticles and "Liposomal AAR029b"

Nano-based systems have been attuned for regulating the release of the medication whereas the nanotechnology needs both synthesis and also manipulation of the nanoparticles as substances. Liposomes have been considered to be vesicular carriers possessing two essential phospholipid layers along with aqueous nucleus. As liposomes consists of cardiolipin and synthetic phospholipids prepared through a procedure of ethanol injection. Therefore, such combination will have an influence upon the anti-HIV activity. Lipid nanoparticles help in enclosing indinavir that has been considered to be antiretroviral drug that tries to recognise CD4 co-receptor.

"Immune-active nanovaccine delivery system"

There is no such specific treatment to cure HIV or AIDS and this HIV infection leads to death in a 5-10 years period. Henceforth, lifetime treatment is used to improve the quality of health of HIV patients. However, ***HAART*** ("highly active antiretroviral therapy") or ***ART*** ("Antiretroviral therapy") has become very effective in the current treatment of HIV along with ***ARV*** (Antiretroviral) drugs as medications [7]. ARV drugs can be classified on the basis of the lifecycle phases of retrovirus. ARV drugs inhibit the lifecycle phase of retrovirus including entry, integrase, reverse-transcriptase, protease and

maturation.

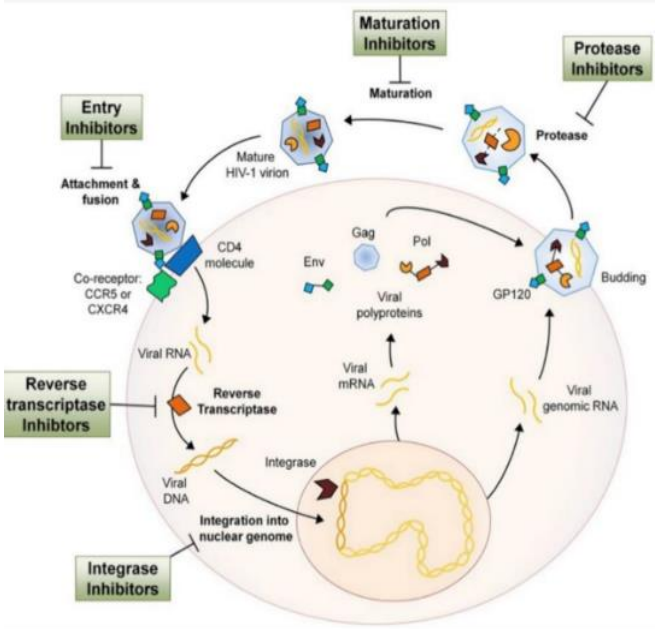

Figure 2: ARV drug against retrovirus life phases [7]

NSs have been widely used along with ARVs for the treatment of HIV as a potential solution in order to overcome the limitations of ARVs. It has been observed that ***niosomes, liposomes, solid-lipid NPs, polymers, nanohybrids and dendrimers*** are mostly used with ARVs [7]. NSs are utilised in HIV treatment for enhancing treatment efficiency, bioavailability and biocompatibility and minimising drug interaction with unrequired targets as well as toxicity. ARV involves specific issues including low stability, insufficient solubility, toxicity and undesired interactions. These constraints have been currently solved by utilising nanocarriers that have tunable properties, high ARV capacity, attached molecules and selective release property of cargo molecules. For instance, synthesised micelles of poloxamines are used with ***"encapsulated efavirenz"*** to maximise its encapsulation capacity sharply up to 8000-fold growth. According to [7], saquinavir loading efficiency becomes high up to 80% with the help of ***"chitosan-based NSs"*** (210 nm) which also increases the cell targeting capacity by 90%.

Detection of "HIV-1 p24 antigen" through gold nanoparticles

HIV needs to be diagnosed at the initial stages to save human life by making patients cured. It has been identified that around ***37.9 million people*** all over the world were diagnosed with AIDS in the year 2018 [8]. Most interestingly, the major proportion (79%) of people came to learn about their HIV-positive status in that same year. ***ART*** has become the most effective clinical access to get rid of AIDS; however, near about ***23.3 million people*** have access to this highly-cost treatment across the globe. In this context, nanoparticles and nanomedicine play a constructive role in HIV treatment and thus it is promoted for having an effective impact on AIDS/HIV. Therefore, gold is used here to assess cellular uptake and biodistribution related to nanoparticles [8]. Moreover, the assessment related to biodistribution aids in analysing suitable in-vitro or in-vivo nanoparticle toxicity. As opined by [8], medical science discovers the utilisation of gold nanoparticles in detecting ***"HIV-1 p24 antigen"*** at early levels through ***BCA*** ("Biobarcode enhancement examination") examination. It improves the detection of HIV at the initial stage and thus early ART treatment is possible to make patients healthier.

Nanotechnology drug therapies

Nanomedicine approaches have been employed in diverse systems on drug therapies or drug deliveries which include areas such as "vivo imaging", "in vitro diagnostics" and others.

Nanotechnology	Drug name	Author name	Reference
Liposomes	Stavudine	Maurya SD	Ref-19
	Lamivudine	Pai R	Ref-20
	Doxorubicin	James ND	Ref-21
	Zidovudine	Kaur CD	Ref-22
	Ritonavir	Ahammed V	Ref-23

Table 2: Liposomes nanotechnology for the development of ARV drugs [9]

The drugs that are encapsulated through liposomes have subsequently achieved therapeutic levels that can be further balanced through PEG gatherings within "synthetic phospholipids" [9]. Different medical investigators have been using this technique of liposomal encapsulation in a way to target the specific drug and act in the form of a curative promoter for those targeted organs. The names of the drugs (for examples, "Stavudine", "Doxorubicin" and others) that can be used with liposomes have been identified as the efficient drug therapy

Nanotechnology	Drug name	Author	Reference
Dendrimers	Zidovudine	Kumar s	Ref-26
	Efavirenz	Dutta T	Ref-27
	Lamivudine	Dutta T	Ref-28

Table 3: Dendrimers nanotechnology for the development of ARV drugs [9]

Dendrimers have been considered to be artificial macromolecules possessing characterised structures containing three components such as "central core", "dense shell with terminal" and also "repetition branch units" [9]. Drug therapy through dendrimers has been appropriate because it has accurate polydispersity and size of nanometer has been permissible as well within the biological membranes. The drug names such as "Zidovudine", "Lamivudine" and others have been recognised according to the above table.

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Usage of nanocarriers in antiviral drugs

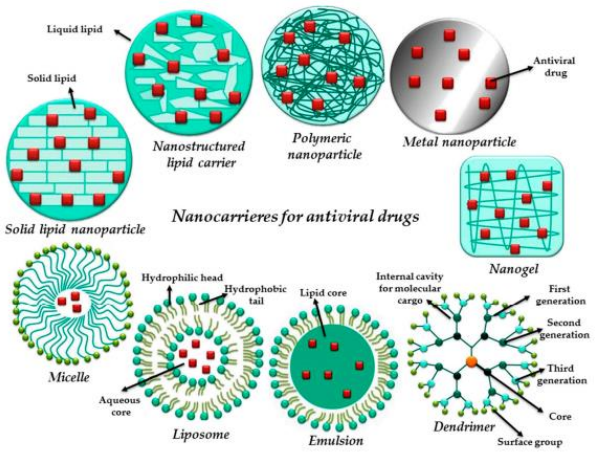

Figure 4: Development of nanocarriers following antiviral therapy [10]

Nanotechnology has provided the modalities for delivering the drug to pass through biological barriers, curb the circulation of drug levels and others. Nanocarriers with distinguished physico-chemical properties are effective drug therapy through nanotechnology for the treatment of the virus. The mechanisms within the "nanomaterial-mediated drug delivery" have been evaluated through its architectures and also particular properties of every nanosystem. The nanomaterials along with the nano-architectures have been utilised as HIV vaccine carriers and adjuvants that have already proved its capabilities.

Nanoplatform Type	Nanoplatform Characteristics (Size, Morphology, Toxicity etc.)	Drug	Virus Type	REF
Liposomes				
- Reverse phase evaporation	• GCV mixed with PC/CH/NaDC dissolved in chloroform/diethyl; • Spherical liposomes; • Liposome sizes of 210 ± 17 nm, ζ-potential—52.4 mV; polydisperse;	GCV	HSV	[125]
- rHDL	• rHDL-nosiheptide complex with a diameter < 30 nm;	Nosiheptide	HBV	[126]
	• rDHL-ACV palmitate complex size of 33.5 nm, around 10 times smaller than ACV-liposomes;	ACV		[127]
- cationic	• Viral gene expression reduce by 65–75% in liver after 2 days of administration at mice;	siRNA	HCV	[128]
- immunoliposomes	• Viral secretion reduced by 81% and free viral particles neutralized in vitro;	HIV gp 120 Folding inhibitor	HIV	[129–131]
	• In vivo resistance to infection has been enhanced;	anti-CCR5 siRNA		
	• Immunoliposomes diameter with average between 100 and 120 nm; really useful to deliver high concentrations of indinavir;	Indinavir		

Table 4: Development of nano-delivery systems for various antiviral drugs [10]

The table is significant as the nanoplatform such as immunoliposomes can be used as drug therapy through the help of nanotechnology. The characteristics of the nanoplatform have been identified as well according to the size, toxicity and others. It has been witnessed that the viral secretion has been curbed by around 81% and also viral particles have been neutralised within the vitro. The diameter of the immunoliposomes has been "between 100 and 120 nm" and has been estimated to be beneficial for delivering indinavir in high concentration. The drug therapy will use a drug such as "HIV gp 120", “anti-CCR5 siRNA” and others [10]. Therefore, there is a high chance of curing HIV through this nanoplatform and these drugs.

Nanotechnology for delivering “CYP substrates”

Nanomaterial		ARVs	Size (nm)	Zeta potential (mV)	Entrapment efficiency (%)
Polymeric nanoparticles	PLGA	LPV	331.2	−13.8	45
	PLGA	LPV	142.1	−27.2	93.03
	PLGA	LPV, EFV, RTV	262	−11.4	45
	PLGA	NFV	185	28.7	72
	PLGA	EFV	200	−25	-
	PLGA	ETR	371.4	−21.0	91.0
	PLGA	MVC	331.6	−26.5	12.0
	PLGA	NVP	93-186	-	20–75
	PLGA	RPV	200	-	-
	PLGA	EVG	47	−6.47	-
	PLGA	EVG	190.2	−19.2	44.6
	CAP	EFV	96.9	−17.08	98.1

Table 5: Nanoformulations for CYP substrates used for treating HIV [11]

The nanoformulations have been prepared for preventing ARVs to overcome the impacts of HIV treatment. The formulation of ARVs is required to be enhanced to control the release of nanoparticles. Most of the protease inhibitors (PIs) (peptide-like chemicals) have been assumed to be CYP substrates in the form of "CYP inhibitors" and "CYP inducers". PIs have first-pass metabolism through "CYP enzymes" where there is a need for pharmacoenhancers such as “***ritonavir***” (RTV) or “***Cobicistat***” (COBI) to attain the therapeutic concentrations for the PIs [11]. In this regard, it can be stated that there is a development of various nanotechnology approaches only to overcome the limitations through PI regimens.

Atazanavir (ATV) is selective and is considered to be an important inhibitor for HIV protease however; CYP3A4 has resulted in a decrease in ATV bioavailability. This limitation from CYP3A4 has been overcome through stearic acid that makes use of Pluronic F68 in the form of an emulsifier. Darunavir (DRV) is the most-prescribed PI used for treating people with HIVs however; these particular ARVs have been termed as poor for oral bioavailability [11]. In case, DRV has been administered by combining it with RTV then it may result in Drug-Drug Interaction (DDI) causing liver disorders as well as hypersensitivity reactions.

"Liposomes-Based Delivery Systems of Ascorbic Acid"

Nanocarrier and Targeting Ligand	Drug	Targeting Sites
	Liposomes	
β-d-1-thiomannopyr-anoside	Indinavir	Liver, spleen, and lungs [120]
d-mannose	Stavudine	Maintained significant levels in the liver, spleen, and lungs and overcame the development of anemia and leukocytopenia [121]
Galactose	Stavudine	Prolonged residence in liver and spleen [122]
Galactose	Azidothymidine palmitate	Liver [123]
Galactose	Azidothymidine	Prolonged residence in the body [122]
d-mannose	Zidovudine	Lymph nodes and liver [124]
Antibodies against human and murine HLA-DR and CD4 antigen	Indinavir	Lymph nodes, liver, spleen, and plasma [101]
	Nanoparticles	
Transferrin	Azidothymidine	Brain [125,126]
Mannan	Didanosine	Spleen, lymph nodes, and brain [127]
d-mannose	Didanosine	Lung, liver, and lymph nodes [128]
Trans-Activating Transcriptor (TAT) peptide	Ritonavir	Brain [129]
	SLN	
Transferrin	Saquinavir	Brain microvascular endothelial cells [130]
Bovine serum albumin	Stavudine	Liver, spleen, brain [131,132]
Dextran	Stavudine	Liver, spleen, brain [132]

Table 6: Anti-HIV1 drugs delivered to reservoir sites [12]

"***Liposomes-Based Delivery Systems of Ascorbic Acid***" has been witnessed to possess the potential for reducing oxidative stress and also prevent many chronic conditions of HIV. This strategy may assist during the time of oral administration of the respective ARTs [12]. In this scenario, there is a requirement for several researchers and also trials to evaluate the effect of vitamin C on the selected disease. The drug-loaded carrier based on nanotechnology has been found to help target anatomical along with "cellular viral reservoirs" that subsequently eradicate the virus from the sites of the reservoirs [14]. The nanocarriers provide drug therapy controllably that helps in incrementing bioavailability and also enhancing life quality among HIV patients [15]. The liposomes as drugs have been identified in the above table such as "Indinavir", "Stavudine", "Azidothymidine palmitate" and others that have been targeting different sites such as liver, spleen, lymphnodes and others.

Formulation of nanoparticles through PLGA

The preparation of ***"polymeric nanoparticles" (PNP)*** has earned great interest and success in biomedical science and research. It has been recognised that ***PLGA*** ("poly lactic-co-glycolic acid") is used successfully in constructive "drug delivery systems" due to its low toxicity and high biodegradability. PNP can be formulated from PLGA of the size range 10-1000 nm through different methods including ***nanosolvent displacement, phase-inversion, solvent diffusion*** and ***emulsification evaporation*** [13]. However, nanoprecipitation and "emulsification solvent evaporation" are used the most to prepare PNP from PLGA. As per the studies of [13], the mixture of aqueous solution and a "non-water miscible solvent" is emulsified under the action of high shear force in the emulsification method. Thereafter, the volatile solvent evaporates and forms PNP; this method produces nontoxic nanoparticles with a rapid reaction rate. On the other hand, the nanoprecipitation technique involves a single step by using miscible solvents. This technique involves specific advantages such as adequate reproducibility, simplicity and low input of energy. It is important to eliminate potential toxic impurities such as surfactant extracts, organic solvents and polymer aggregates from the PNP after nanoparticle formulation. According to [13], ***gel filtration, ultracentrifugation, dialysis*** and ***evaporation*** are some crucial examples of lab-based purification methods.

CONCLUSION AND RECOMMENDATION

The article has focused on the application of nanoparticle technology in drug therapy in terms of curing AIDS/HIV. It has been noticed that nanoparticle technology has become one of the most interesting fields in biomedical science. Fifteen authentic journals have been selected in this study to misconduct a systematic review in order to gather and discuss key information on the chosen topic. Liposomes are used for synthesising biodegradable nanoparticles such as ***"liposomal AAR029b"*** where ***"CD4 co-receptor"*** is used to recognise different nanoparticles that are used in ARV drugs. The process of nanovaccine delivery has been evaluated in this article with ART treatment. Furthermore, gold nanoparticles have been recognised as an effective biocompatible substance that can detect ***"HIV-1 p24 antigen"*** at an early stage so that treatment can be proceeded as soon as possible to cure patients. Along with this, the application of

nanoparticles in antiviral drugs and drug therapies has been assessed in this article. Nanoparticles have been recently generated from CYP substances and PLGA that influence the application of nanoparticles in drug therapy against retrovirus and HIV. However, there is no such specific treatment for HIV that can completely cure patients. Thus, more research work and investigation named simulation need to be conducted to develop ART and drug therapy based on nanotechnologies to improve the medical treatment against AIDS/HIV.

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