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UNDERSTANDING NOVEL POLYMER AND LIPID BASED CARRIER SYSTEMS IN CLINICIAN PERSPECTIVE

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Abstract:
From the past two decades, technological advancements in science and chemistry made possible many new drug delivery systems that have the potential to completely change the course of routine therapeutic ways. Lipid and polymer-based drug delivery systems are considered to be the pillars of many drug dosage forms, irrespective of their route of administration. With increasing knowledge on their chemistry, lipids and polymers are being modified and used as potential novel drug delivery systems with smart polymers and lipid nanotechnology paving the way for efficient drug delivery into the patient. This review article covers the swing of these drug delivery systems in the current market and interpreting all this from a health care professional's point of view.
Keywords: Gene delivery, Lipid based drug delivery, Polymer based drug delivery, Target specific drugs, Solid lipid nanoparticles

Introduction:

Lipids and polymers have always been major components for drug dosage forms. Earlier for centuries lipids and polymers were extracted from natural sources, but recent advancements have made possible manufacturing of many synthetic and semi-synthetic lipids and polymers providing drug formulators with many options for synthesizing efficient drug delivery system for different administration routes [1]. Although they are different in structures, they are usually appointed for similar roles. However certain major differences such as melting point, bioavailability, and some mechanical properties make them assigned in different roles. The main aim of all the health care professionals is to provide the patient with efficient treatment preferably with target-specific drugs which would give better results. Lipid and polymer-based drug delivery systems made this possible [2]. The main factors that determine the efficacy of a drug are bioavailability, safety, and stability; these drug delivery systems are showing promising results in all these factors. However certain precautions are followed by clinicians and other health care professionals before formulating, manufacturing, and prescribing these systems via different administration routes [3]. Results of several clinical trials on these drug delivery systems gave optimistic outcomes and post-marketing surveillance reports are also positive except in some cases. HPLC is used to determine the quality and to estimate and validate [4][5]. Nanoethosomes and nanoemulsions are revolutionary carrier systems promoting better drug delivery and bioavailability [6] [7]. Chitosan and Alginate, these natural polymers are in use for drug delivery for the past decade [8][9][10]. In the same way nanofibres and nanowires are suitable and favorable for tissue engineering and bio-sensible applications and are manufactured by a process known as electro-spinning [11][12][13]. Synthetic polymers such as polyvinylpyrrolidone (PVP) are used in industries for dispensing and suspending drugs [14][15]. PVP is also in consideration for manufacturing a controlled drug delivery system for COVID-19 treatment [16]. Liposomes are also modified into a thin film for use as trans-dermal patch for treatment of various ailments [17].

TRENDS IN MARKETED LIPID AND POLYMER BASED DRUG DELIVERY SYSTEMS:

An overview of recent advancements in lipid and polymer-based drug delivery systems that are in the market approved and prescribed by health care professionals and showing promising results.

1. Controlled release matrix systems [18]:

Polymeric tablets are much suitable for the manufacturing of these systems with different dosage ranges.

Example of polymers: Vinyl polymers, Methylcellulose, polysaccharides.

Drugs Example: Verapamil [19]

2. Lipids and Self emulsifying drug delivery system [20][21]:

Lipid-based excipients are widely used now to formulate Self-emulsifying drug delivery system(SNEDDS and SMEDDS) [22] to increase bioavailability.

Example: Medium-chain triglycerides

Drugs: Ritonavir

3. *Amorphous solid dispersions [23]:*

Polymers are used to stabilize the dispersion. Polymers are also used for coating purpose [24].

Example: ω-carboxyalkanoate-modified cellulose polymers

Drug: To stabilize Rifampin [25]

4. *Lipidic and polymeric vesicles [26]:*

Liposomes and polymersomes are used to load and deliver hydrophobic and hydrophilic drugs in a controlled way. Okra- thioglycolic conjugate is used as a mucoadhesive polymer [27].

Example: PEGylated liposome

Drug: Formulation of Doxorubicin for AIDS/Multiple myeloma/ovarian cancer [28]

5. *Polymer-based micelles and nanoparticles [29][30]:*

Polymer-based nanoparticles and block copolymer micelles are the most advanced outcomes.

Example: PEG-b-poly micelle system [31] [32]

Drug: Triolimus (Paclitaxel, Rapamycin, demethoxygeldanamycin) [33][34][35]

6. Lipid and Polymer-based nanocarriers for pulmonary nucleic acid delivery [36]:

Lipoplexes and Polyplexes are the most potential nanocarriers for the delivery of nucleic acid to the lungs. Zein a natural polymer is also used for gene delivery [37][38].

7. Smart polymers for drug delivery [28][29][39]:

These drug delivery systems are sensitive to stimuli such as temperature, light, pH, and also known as intelligent drug delivery systems.

Example: In- situ gel; These are in solution form before entering the body and after administration into the body undergoes gelation and converts into gel (PLGA) [40][41][42].

CLINICIAN'S PERSPECTIVE IN PRESCRIBING MARKETED LIPID/POLYMER-BASED DELIVERY SYSTEMS TO PATIENTS:

With growing interest in the field of chemistry of various molecules, the technology is moving forward at a high pace. The same is with the advancements in drug dosage and delivery systems [43][44]. Various new drug delivery systems with lipids and polymers as backbone are proving effective in many therapies and clinicians all over are prescribing these drug delivery systems for better treatment. As per statistics the patients who were treated with novel lipid or polymer-based drug delivery system via various administration routes showed better results when compared to other studies. For example proliposomal gel has been proven as an effective topical pharmacotherapy [45][46][47].

Health care professionals aim for better treatment of patients with zero adverse effects and complete therapy, hence formulators and pharmaceutical companies aim to manufacture these lipids and polymer-based drug delivery system to promote better bioavailability and safety [48][49]. Health care professional's review and feedback is also most important when it comes to formulation of these novel drug delivery systems as after clinical trials the clinicians and other health care professionals are the ones who treat 'n' number of patients hence observe and understand the complete safety and efficacy of these drug delivery systems in patients [50][51][52].

However, before prescribing drugs which are lipid and polymer-based the health care professional needs to follow some precautions to prevent any adverse effects in the patients [53]. In hypertension patients, lipid-based drugs need to be cautiously given or avoided because they may have some serious effects on the patient. Also, the previous medication history of the patients needs to be understood by the clinician or doctor to check if there may be any serious interactions between the drugs [54][55]. Also any -pre-existing medical conditions or diseases should be monitored to promote better efficacy and safety of the drug [56]. The major problems for any dosage forms are bioavailability, safety, efficacy, and stability. The main goal for formulators is to manufacture a dosage form with increased bioavailability, better efficacy, and stability and also to promote safety in patients [57][58]. The major advantage in polymer and lipid-based drug carrier systems is increased bioavailability in patients. Targeted therapy is more efficient through lipid and polymer-based carrier systems, due to which the bioavailability is increased and therapy is escalated [59][60].

Conclusion:

After centuries of use of lipids and polymers for various health uses, the complete potential of them is slowly unraveling with advancements in technology. Both lipids and polymers have major skillfulness which are giving fascinating results in different routes of administration and also different compositions. Healthcare professionals and clinicians should first thoroughly understand lipid and polymer-based carrier systems and any adverse effects they may have on patients with pre-existing health conditions. These carrier systems have a great potential to pave way for many breakthrough therapeutic inventions and clinicians play a major role in understanding the complete efficacy and capability of these drug carrier systems in all groups of patients. Ultimately for clinicians, polymers, and lipids based carrier systems remain

indispensable tools to address the challenges posed by certain complex diseases.

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