Nano carrier as drug delivery system and their associated complications

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Nano carrier as drug delivery system are rapidly spreading due to their more specificity towards particular receptor and show there action at specific site. Due to this property they are use specifically in cancer treatment. Nano particles are used in novel drug delivery system so as to reduce toxicity but nano carrier themselves becoming the reason for the toxicity.[1]

Recent development in medicine has bring advancement in diagnose and treatment of disease but it also causes many hazards due to there toxicity. Nano particles have large surface area which binds to the surface of targeted receptor or cell, absorb at the surface and carry many drug particle or proteins. However, many challenges may overcome if the application of nano particles is improved and pathophysiology of disease is properly studied.[1]

Nano particles may be synthetic or natural based upon their property the toxicity and action differs. So, for this the evaluations of nano particles are needed to be done. They may show different effects from previous effects. The main effect is shown on the brain as mentioned in various papers and articles.[1]

Challenges with administration of dosage form

The main routes for administration of any drug dosage form are Intravenous, Intramuscular, Intranasal, Intradermal and oral dosage form. Other routes are also there for the administration such as ocular delivery which have been developed for localized and site-specific delivery of drug.[2] The nano particles are advanced technology in medicine and dosage form not always these routes mention above show there effect so nano particles emerged in the pharmaceutical areas. Drug like proteins or nucleic acid require more innovative carrier to target the active pharmaceutical ingredient and administer drug to required site. [3] Absorption mechanism and nature of the drug determine the delivery system for better bioavailability and better efficacy.[2]

In IV administration the drug particles directly go into the blood stream and injection is injected through needle which may cause pain and high concentration of the drug is injected. If drug may cause toxicity it is unable to withdraw the drug.[2] In IM administration of drug it is administered through the im route which may avoid the gastrointestinal environment but it causes the significant problem like toxicity.[2]
In oral administration the drug may come in contact with gastrointestinal environment which may waste the drug and may don’t reach targeted site. The main obstacle for orally administering is classified under biological and technical challenges. Biological includes biological factors that detoriate the drug which is administered [2].

Targeted drug delivery

Targeted drug delivery systems are the system which deliver drug at targeted site or specific site of action. Nano particles are one of the delivery system which is advanced drug delivery system which may be synthesized from natural or synthetic polymer system. The main objective of the nanocarriers is to contact the target site, identify the receptor, bind to specific receptor, minimized or avoids drug induced toxicity. [3]

Table 1: Application of nano carrier drug delivery system [4]

<table>
<thead>
<tr>
<th>Nano carriers</th>
<th>Drug(s)</th>
<th>Tumor</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>SLNs</td>
<td>5-FU, doxorubicin, paclitaxel, methotrexate</td>
<td>Colon, breast, lungs, pancreatic</td>
<td>Solid lipid nanoparticles are made employing simple double emulsion method which provides flexibility and less process-related stress on the active molecule which is encapsulated. Due to this SLNs can be used for the cancer treatment drugs which are soluble in aqueous phase.</td>
</tr>
<tr>
<td>Liposomes</td>
<td>Doxorubicin, cisplatin, Doxil</td>
<td>Breast, lungs, colon</td>
<td>The process associated with encapsulation of active pharmaceutical ingredient provides significant anticancer activity and reduced cardiotoxicity</td>
</tr>
<tr>
<td>Dendrimers</td>
<td>Methotrexate, 5-FU, cisplatin, doxorubicin</td>
<td>Breast, skin, lungs</td>
<td>Induction of drug conjugates into the tumor cells, enhances antitumor activity as well reduces toxic effects. The conjugates have shown controlled delivery mechanism specifically drugs associated with cancer treatment.</td>
</tr>
<tr>
<td>PNPs</td>
<td>Doxorubicin, docetaxel, paclitaxel</td>
<td>Breast, chronic myeloid</td>
<td>An intravenous injection of doxorubicin conjugated to PLGA NP has shown tumor suppression over daily injection of free doxorubicin over 12 days; hence showing that</td>
</tr>
</tbody>
</table>
cisplatin, imatinib mesylate  

#### PMs
- Methotrexate, cisplatin, paclitaxel, docetaxel, doxorubicin
- Breast, skin, lungs
- Polymeric micelles enhances the anticancer drug circulation time of cancer treatment drug in the blood

#### CNTs
- Methotrexate, cisplatin, paclitaxel, doxorubicin, tripiscian, carboplatin, mitomycin C
- Lungs, breast, skin
- They have distinctive physicochemical properties like enhanced drug encapsulation, intrinsic stability, mechanical flexibility, appropriate surface functionalization

Hazards and complication of nano carrier:

The use of nanotechnology in nanomedicine is done and attention is given while using for drug delivery and studies should be done for safety and efficacy. The nano formulation, toxicology studies are necessary. When these are used their effect is more specific in any kind of toxicity.[1]

The studies related to adverse effects of nanoparticles has obtained from inhalation toxicology which include PM10 literature(particulate matter with size below 10mm), “Nano particles hypothesis” showas significant research. The evidence is stated in table 2 [1]

<table>
<thead>
<tr>
<th>Type of particle</th>
<th>Explanation</th>
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<tr>
<td>PM10 PM25</td>
<td>In ambient air the particle fraction along its mean diameter of 10 to 25 µm respectively.</td>
</tr>
<tr>
<td>Coarse particles</td>
<td>The mass fraction of PM10 which is bigger than 25µm</td>
</tr>
<tr>
<td>PSP</td>
<td>The drugs which are badly miscible particles with less toxicity may be fine or ultrafine.</td>
</tr>
<tr>
<td>CDNP</td>
<td>Combusion derived nanoparticles</td>
</tr>
<tr>
<td>DEP</td>
<td>Diesel exhaust particles</td>
</tr>
</tbody>
</table>
Effect on blood and cardiovascular system

Ligand coated engineered nanoparticle are applicable to drug delivery system. The properties of the molecules is such that which causes diffusion in tissue without interfering in the normal functioning of tissues. Cationing nano particles that include gold and polystyrene causes heamolysis and blood clotting.[1]

Effect of nano particles on Brain

Nano particles can effect brain through these mechanism, i.e. (1) Transsynaptic transfer past inhalation via olfactory epithelium and (2) uptake all the way through the blood-brain barrier. The various research shows that physiological barrier may restrict the proteins delivery after deliverance to the brain. Studies shows that well brain barrier has natural defence mechanism against any particles which protects the brain exposure of foreign particle.[1]

Engineered nano particles with complication

Carbon nano tubes

These nano tubes may be single wall or multi wall when they administered the soluble core of nano tube breaks in to organic material and metal, metal causes toxicity in the body. Insoluble part will causes translocation effects in the sites distal to the lungs which in end result in the oxidative stress, inflammation and 8-OH-DG.[5]

Quantum dots

Quantum dots are nano particles there absorption, distribution, excretion and metabolism also there toxicity depends on the multiple factors depend on physiological and environmental conditions.

Dendrimer

Dendrimers are the nano particles range from 0 to 10 nm which is well suited for the delivery of drug material. The main complication with dendrimers are that it is very difficult to assemble dur to thier size.

Reference


