The Use of Iron Oxide Nanoparticles for Cancer Therapy

By

KRITIKA KASHYAP

PALLAVI PRADEEP

VELLORE INSTITUTE OF TECHNOLOGY

Introduction

- Cancer is described as the most hazardous class of disease categorized by uncontrolled cell growth .
- In comparison with large bio molecules such as antibodies, receptors and enzymes. NanoParticles can undergo many interactions with biological molecules both on the surface of and inside the cells due to their size which may revolutionize cancer diagnosis and treatment.
- The most commonly studied NPs include quantum dots , carbon nanotubes, paramagnetic NPs, liposomes , gold NPs [21], polymeric, lipid and silver NPs.

Lipid and polymeric NPs have been used to encapsulate therapeutic molecules to increase drug solubility, safety and delivery efficiency based on the enhanced permeability.

Figure 4: Schematic diagram showing uses of iron oxide nanoparticles in biomedicine.

Super paramagnetic iron oxide nanoparticles (SPIONs) are small synthetic α-Fe2O3 (hematite), γ-Fe2O3 (maghemite) or Fe3O4 (magnetite) particles with a core diameter ranging from 10 nm to 20 nm.

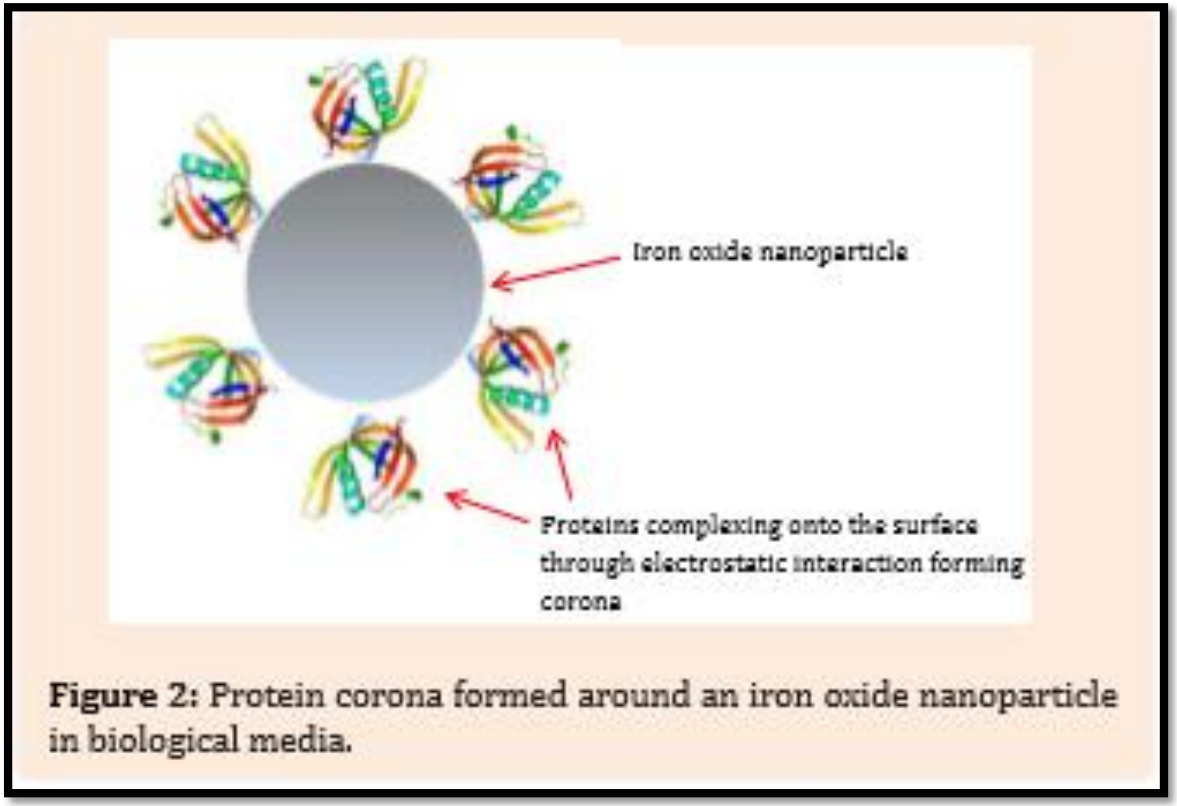

Figure 2: Protein corona formed around an iron oxide nanoparticle in biological media.

Iron oxide for MRI

- The drawback of MRI is that it requires high concentrations of contrast agents because it has low sensitivity. Making aggregated particles of iron oxide increase the sensitivity.
- The signal between contrasted and non-contrasted areas becomes significant due to the use of SPIONs.

Iron oxide for magnetic hyperthermia

- Magnetic crystal suspensions of iron oxide NP's store the energy of alternating magnetic fields and release this energy as heat causing hyperthermic stress in cancer cells.
- In targeted magnetic hyperthermia treatment of cancers, MNPs act as thermal seeds under an alternating magnetic field . Increasing temperature above 40°C improves the radiation effect and causes thermoablation (destruction due to high temperature) of the cancer cells.

Iron oxide nanoparticles as vehicles for chemotherapy

- The primitive aim is to bind the targeting, therapeutic or imaging moiety without compromising its functionality.
- The surface of iron oxide NPs can be modified with anticancer drugs such as doxorubicin (Dox), Catechin–Dextran and Paclitaxel . Catechin-Dextran conjugated Endorem NPs increase the intracellular concentration of the drug compared with the free drug.such a formulation induceds apoptosis in 98% of human pancreatic cancer cell line placed under a magnetic field.
- enhances the anticancer activity of the drug and provides a novel means for targeted drug delivery to tumor cells driven by magnetic fields.

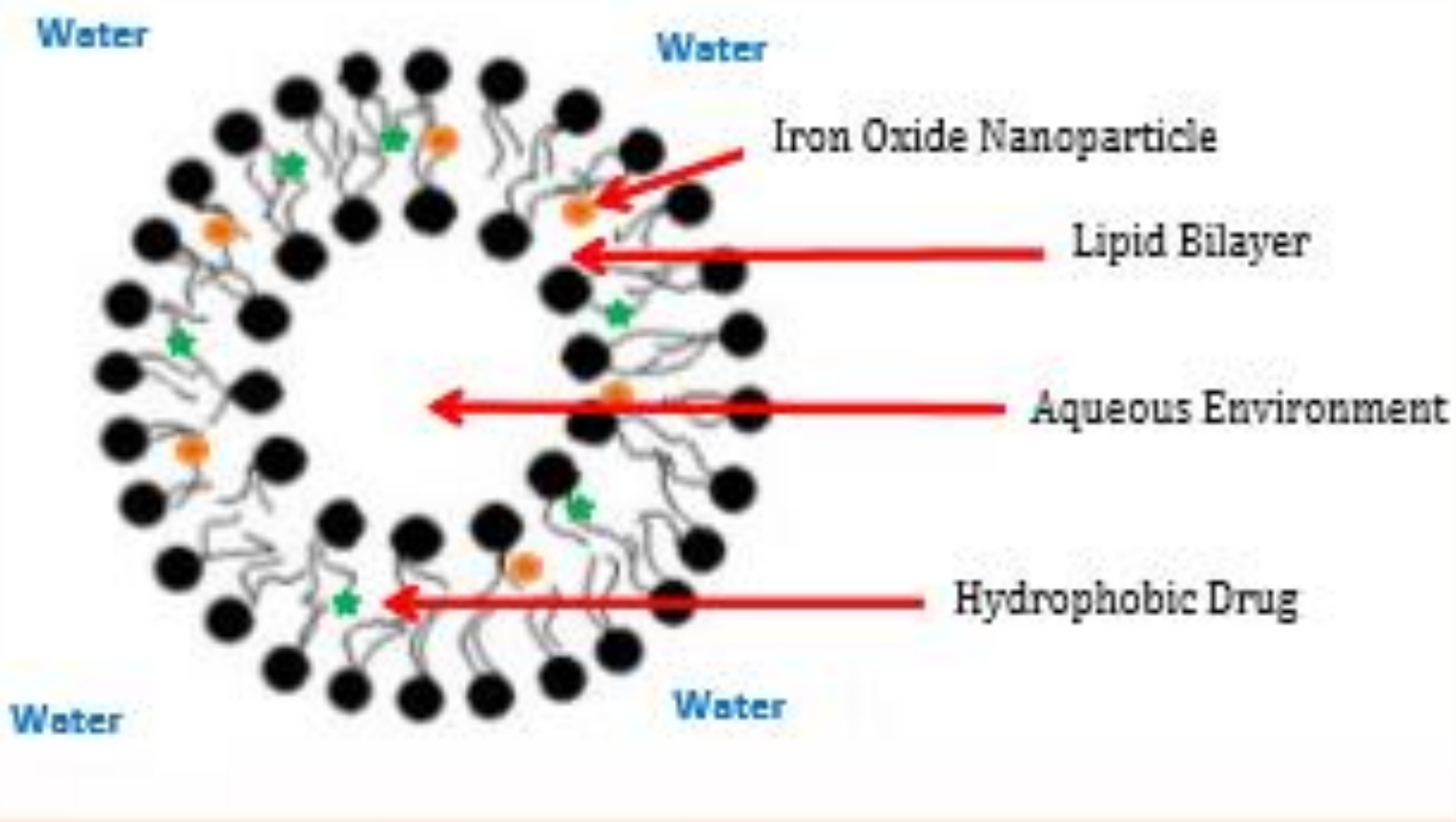

Figure 8: Schematic diagram of a magnetic-liposome encapsulating a hydrophobic drug.

Conclusion

- Iron oxide nanoparticles hold potential as an imaging and chemotherapy agent.
- Rapid diagnosis and treatment using iron oxide may hold the key to improved clinical outcomes and patient quality of life.