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Thermo-responsive and Biodegradable Polymeric Systems for Drug Delivery and Tissue Engineering

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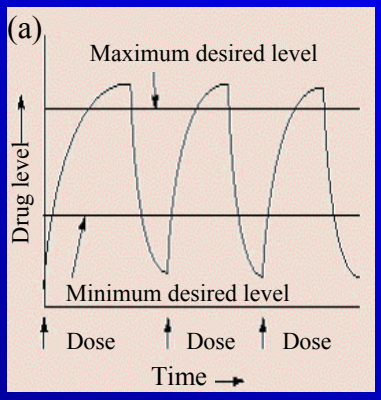
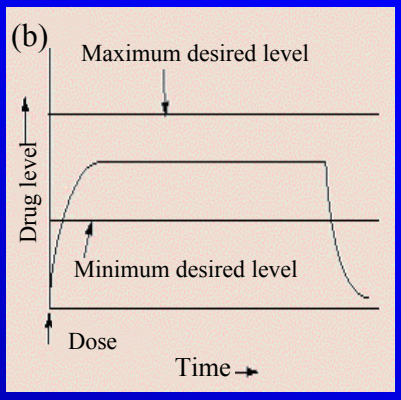
Why Drug Delivery

- Cost of developing the average new drug is approximately $150 million.
- Half-lives of protein drugs are very short.
- Drugs slowly penetrate tissue barriers.
- Drugs release rapidly.
- Undesirable concentrations.
- Wrong places and side effects.

Drug Levels in the Blood





(a) Traditional drug dosing (b) Controlled delivery dosing

Roseman TJ and Yalkowsky, ACS symposium Series, 1976

Future Challenges for Drug Delivery

Design biomaterials to control the release (optimal dose, rate, time or site) of active agents that will create desired effects within the body.

Gene therapy: Develop systems that control release of genetic materials into diseased cells to restore the function of the absent or distorted gene.

Design Biomaterials for Drug Delivery

Requirement: chemically inert and free of leachable impurities; An appropriate physical structure, with minimal undesired aging, and be readily processable.

Design Biomaterials: Polymers (block, grafting, star, hyper-branched, cross-linking), ceramics (piezoelectric ceramics), metals (metal alloys), carbons, glasses and composites.

Classification of drug delivery systems: microparticles, hydrogels, nanoparticles, micelles, liposomes, dendrimers, planar Membranes.

Future Challenges for Tissue Engineering

Problems in available scaffolds

- Insufficient cell migration to establish adequate cell↔ extracellular matrix, cell↔ cell adhesion and cell↔ cell communication, all critically important tissue level functions (*Donahue 2000*).
- Inflammatory reactions to scaffolding materials (*Babensee 1998).*
- Optimal scaffold characteristics (including chemistry, topography, and surface energy) and morphology (including porosity, pore size, and pore connectivity), have not been identified.*(Bouan et al. 2001).*

Challenges

Develop scaffolds that encourage tissue regeneration and differentiation, accelerate wound healing, and modulate neural repair.

Summary

Thermo-responsive and biodegradable polymers have great potential in sustained and targeted release of therapeutic agents for the treatment of Alzheimer's disease and other neurological disorders, diabetics and cancer, bone and cartilage repair, and the treatment of other human diseases

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