





HELLENIC REPUBLIC National and Kapodistrian University of Athens



# Nanotheranostic materials for cancer therapy and diagnosis

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### DRUG NANOTECHNOLOGY

- Therapeutic Benefits
- Carrier for hydrophobic entities
- Multifunctional Systems
- Targeting groups
- Image Contrast Agents
- Coatings with functionalities
- ➢ Pegylated
- ✓ Solubility
- ✓ Reduced toxicity

➢Increase the residence time of systemic circulation

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Targeting

Molecule

Corona

Core

**Image Contrast** 

Agent

Drugs

PEG

(polyethylene glycol)

Nanomedicine: Could Nanotechnology helps the nanotechnology ancer?

### TUMOR CHARACTERISTICS AS A USEFUL KEY FOR TREATMENT SELECTION

- □ Acidic pH: The lower pH is because the high glycolytic activity that produces acids equivalents in the cell
- □ Increased temperature: the higher T° is because the cell is continously replicating, this process needs and releases energy. Also, the increased glycolytic flux araises the T° of the cell.
- **Gamma** Redox environment:
- □ Overexpressing different factors: e.g. Receptors
- □ Low cellular oxygenation levels: if oxygen is limited the Krebs cycle in the cell breaks down glucose incompletely to produce lactic acid.



□ Angiogenesis: neovascularization (by Judah Folkman's research on angiogenesis), and perfusion through the microvasculature is the body's principal means of heat transfer.

### **NANOCONTAINERS SYNTHESIS**



- ✓ Creation of a large void
- ✓ The use of surfactant is avoided
- ✓The cavity can be enlarged after solvent etching

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SEM images of different stages in seed polymerization, a) Seeds of PMMA, b) Strawberry-like surface in which a small cavity was formed, c) Hollow spheres



### **NCS FUNCTIONALIZATION WITH MNPS & FOLIC ACID**



### **RELEASE STUDY**



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### **CELL VIABILITY ON MCF-7**



C (μM)



### **CELLULAR UPTAKE BY LOADED FITC-TARGETING NCS**



Cellular trafficking of Dox (A) and FA- FITC-Dox loaded (B) NCs in HeLa cells. The cells were incubated for 4h with the FA-FITC-labeled NCs at 37 °C, followed by live cell imaging. In all experiments cells were treated with either 10 µM of DOX

### **IN-VIVO RESULTS ON TUMOR EFFICACY**



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### **IRON MNPS** vs **IRON MNFLS**



### **CHARACTERIZATION**





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### **HYPERTHERMIA**

### SIZE DEPENDENCE



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### SYNTHETIC SCHEME



### AMINOACID USE AS REDUCTIVE AGENTS





### **BIOLOGICAL EVALUATION**



### LIPOSOMES PREPARATION WITH MNPS AND GOLD



### **DRUG ENCAPSULATION**



### IN CONCLUSION

- The synthesis of Nanocarriers is well NG RIGHT established
- There are many questions □ About the efficiency □ Targeting ability □ Future problems □ Ethic criteria

Until the frog is turn into a prince



974

985

987

199

1997

2004

2020

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IDEAS

TD 1402: Multifunctional Nanoparticles for Magnetic Hyperthermia and Indirect Radiation Therapy (RADIOMAG)







## Thank you for your attention!!!











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