



Radiolabeled Europium Loaded Theranostic Liposomal Nanoparticles for Effective Radioisotope induced Photodynamic Therapy

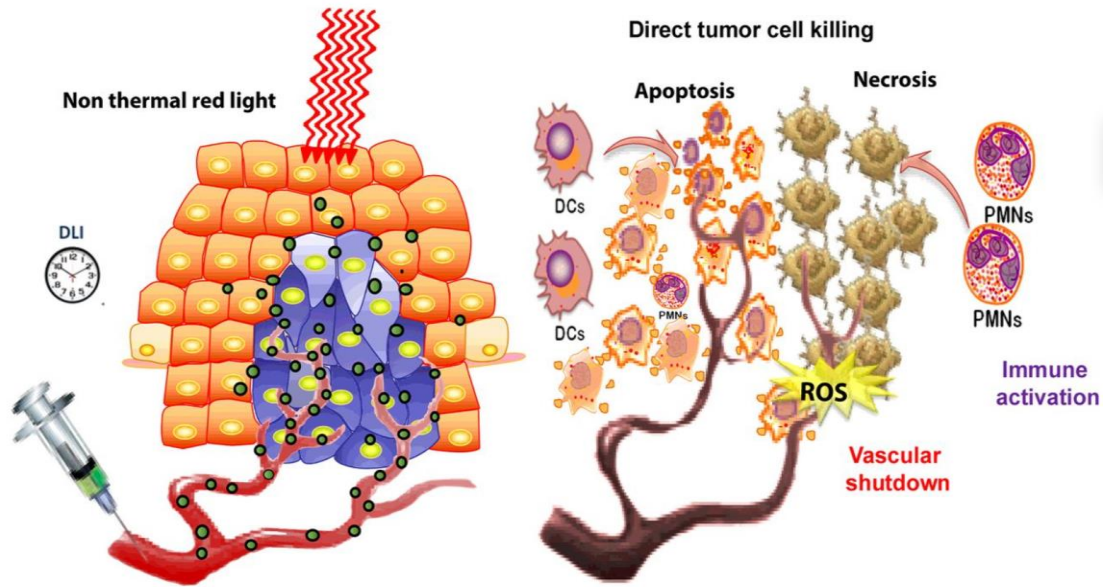
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Anti-Cancer Therapy using **Light** Along with **Photosensitizer (Triggering ROS)**

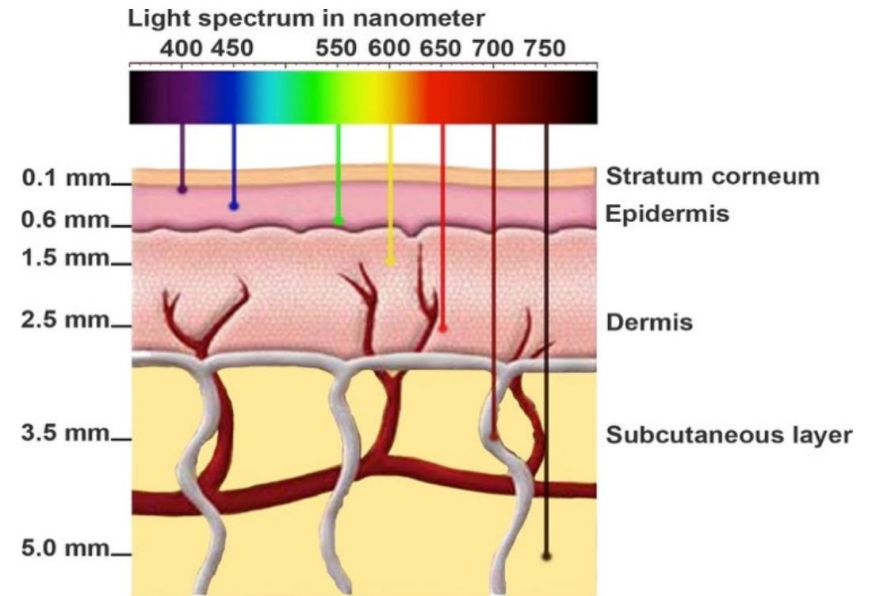
Advantages



Bioscience rep., 2015, 35(6), e00265

- Minimal invasiveness
- Repeatability
- Fewer adverse effects
- Lower cost

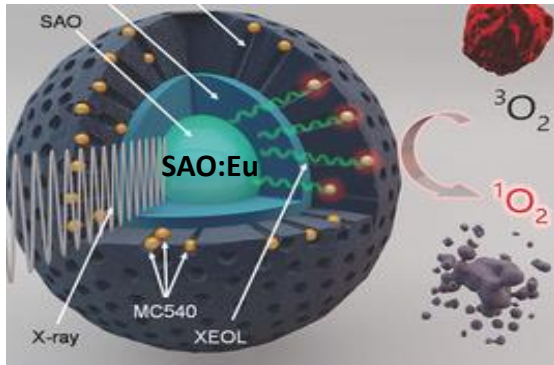
Limitations



Curr. Pharm. Des., 2015, 21(37), 5401-5416

- Less than 1 cm penetration depth
- Large tumor or deep tumor: ineffective treatment

X ray induced PDT



Theranostics, 2016, 6(13), 2295

Strategy

- X ray → Radioluminescence → PDT

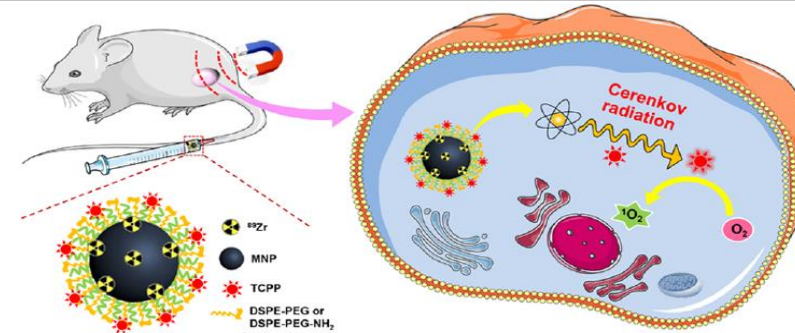
Advantage

- **Strong intensity of radioluminescence**

Limitation

- Additional X ray therapy
- NP with solid core: Limited biosafety

Cerenkov luminescence induced PDT



J. Am. Chem. Soc., 2018, 140(44), 14971-14979

Strategy

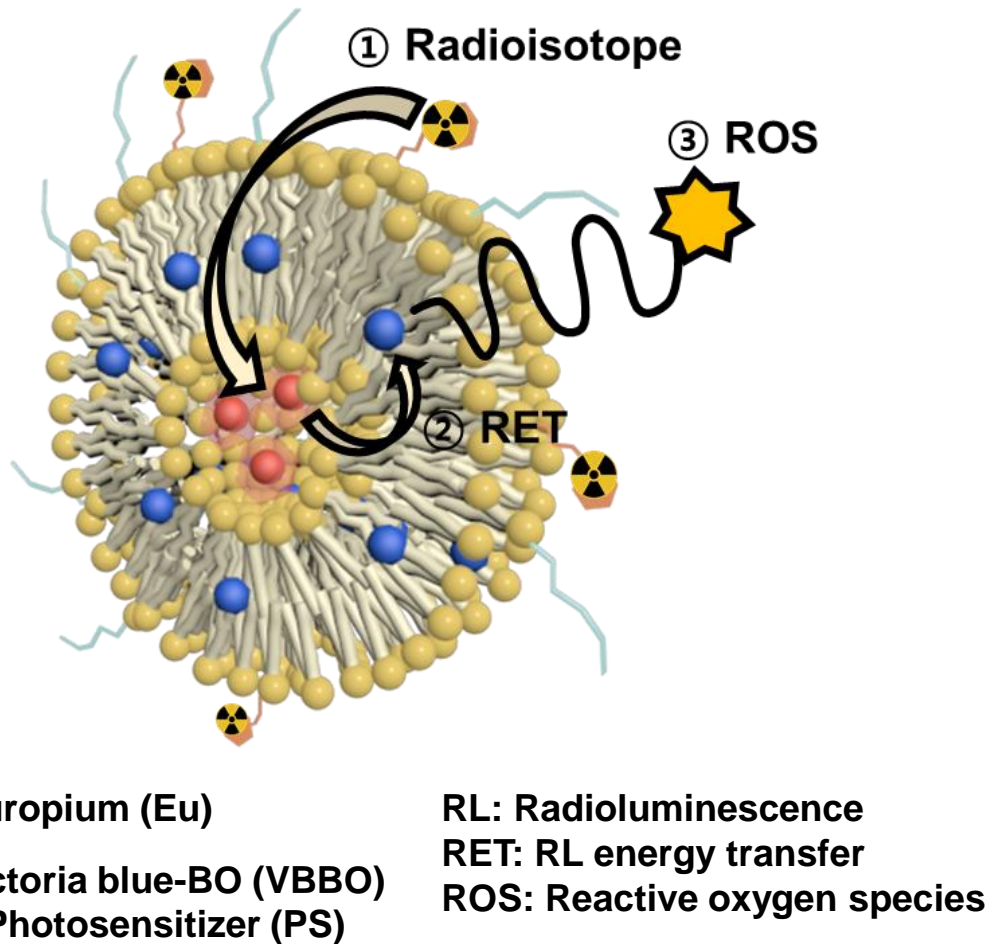
- Particle radiation → Cerenkov luminescence → PDT

Advantage

- **No additional X ray therapy**
- **Longer time of light exposure**

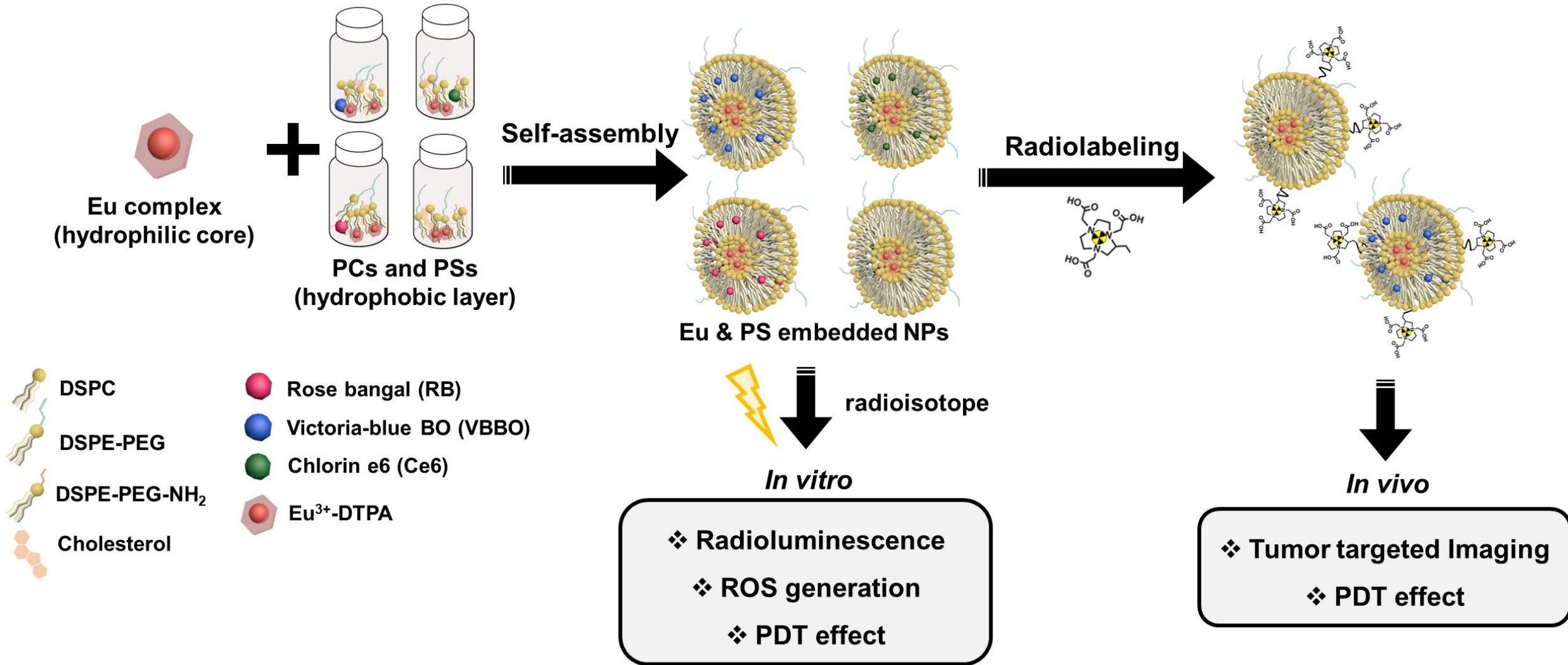
Limitation

- Relatively weak intensity of Cerenkov luminescence
- NP with solid core: Limited biosafety

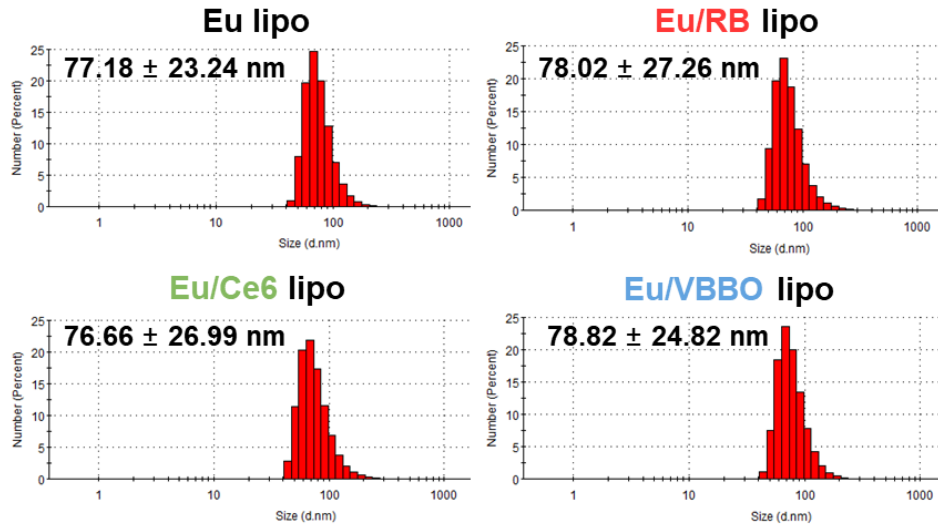


Advantages

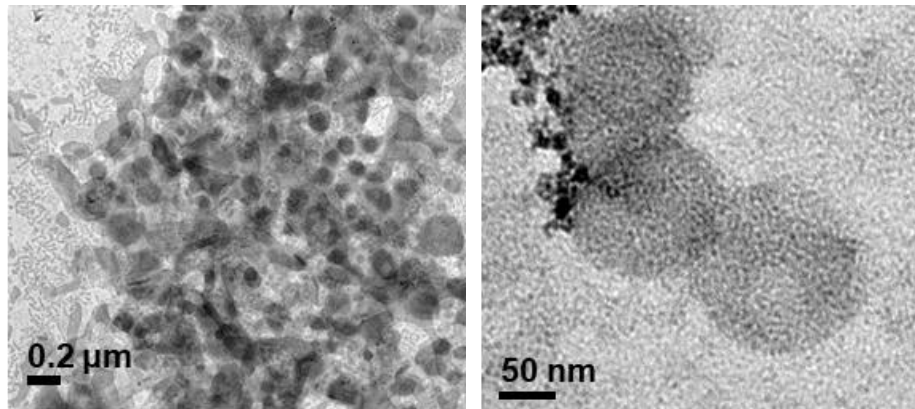
- Radioisotope, Eu and PS loaded
 - Radioluminescence → PDT
 - ✓ No external light
 - ✓ No additional X ray therapy
 - ✓ Potentially higher efficiency than Cerenkov luminescence
 - *In vivo* imaging
- Liposome based / Chelated Eu
 - Biocompatible



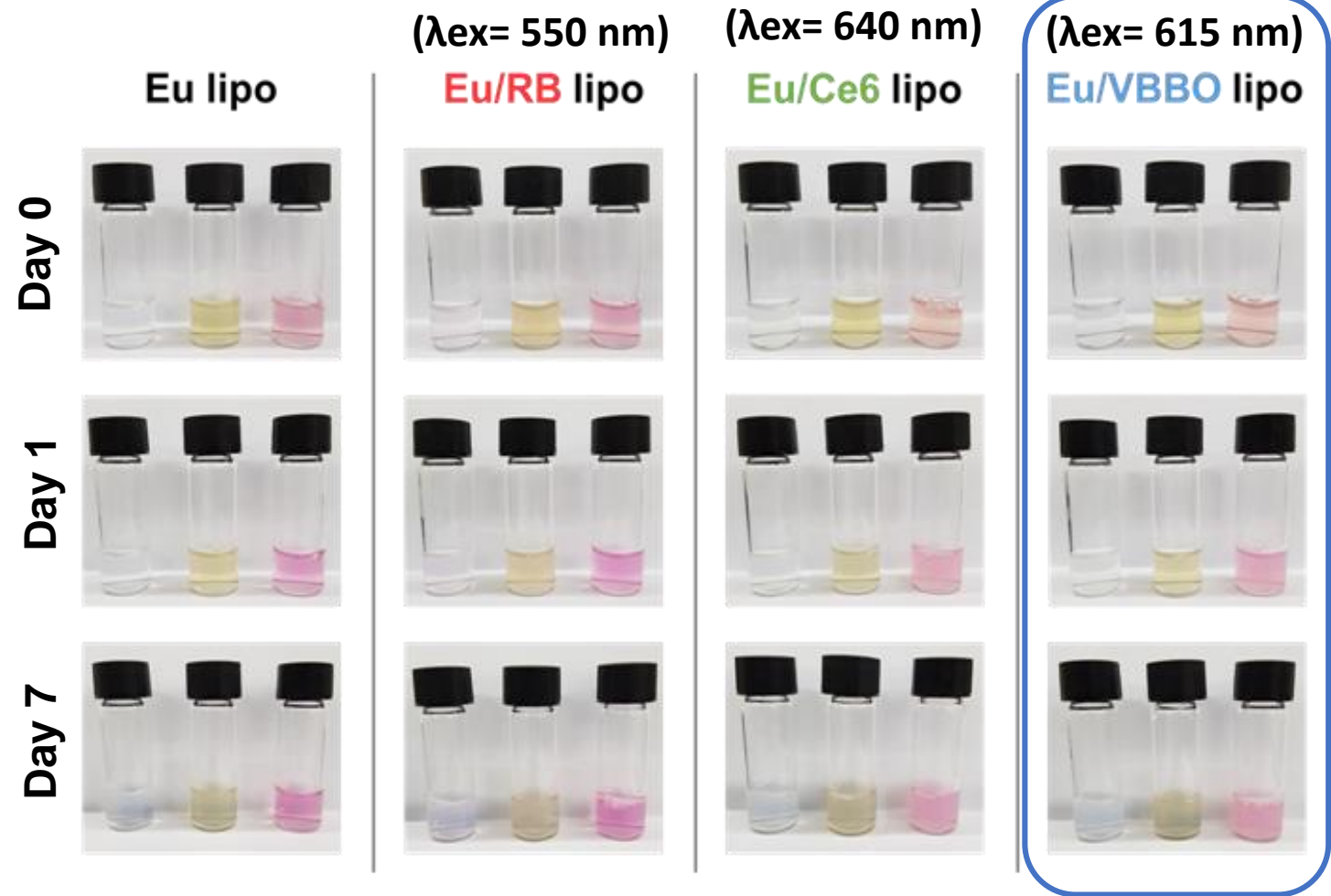
Hydrodynamic size



TEM images

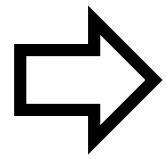
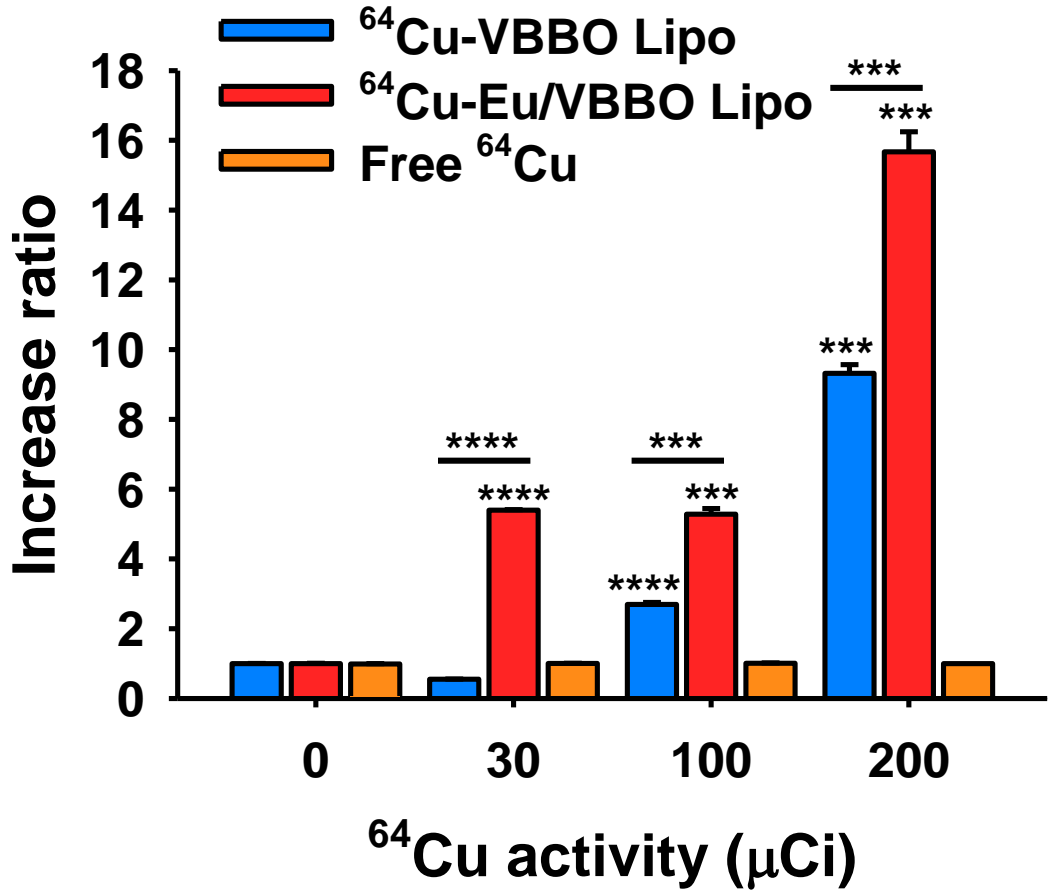


Stability tests in different physiological conditions

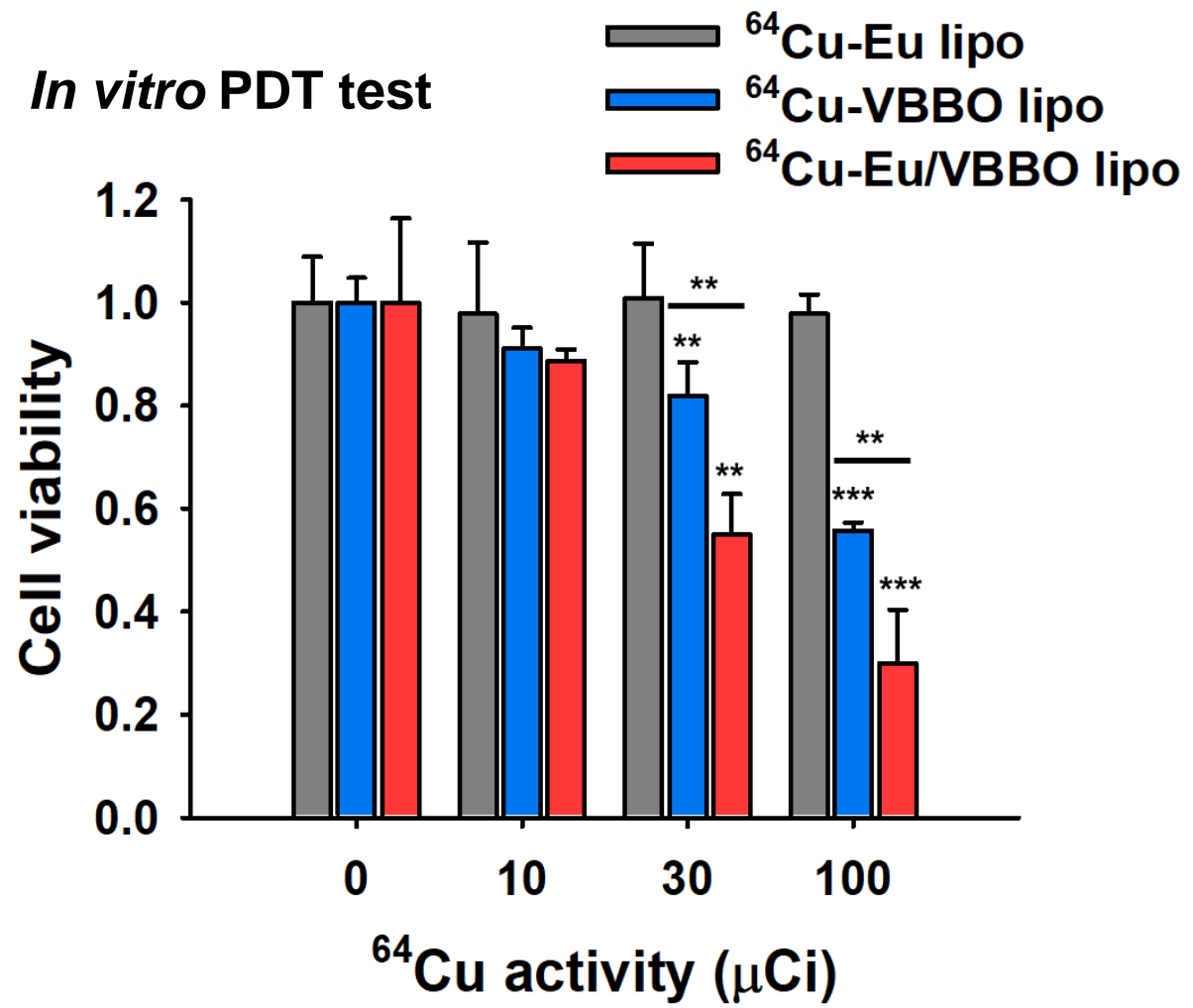


Left: PBS, middle: human serum, and right: RPMI

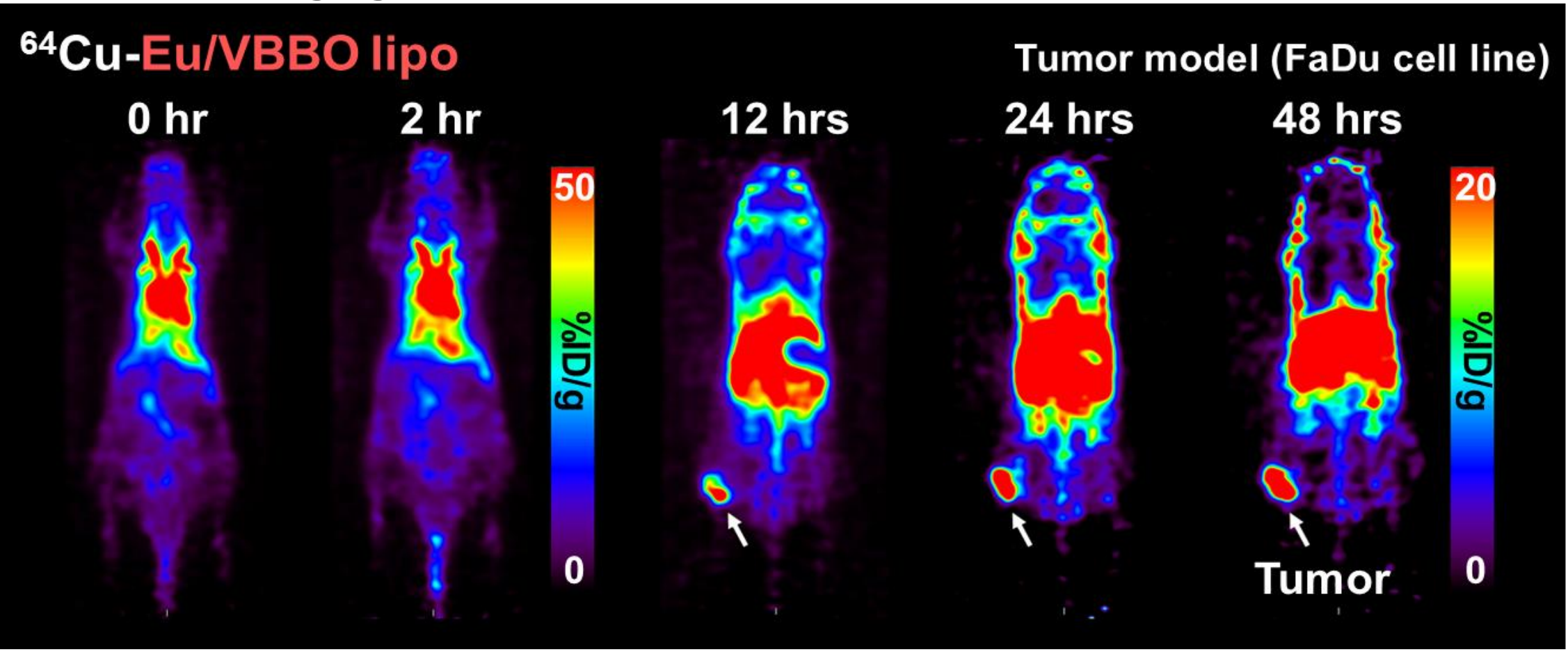
ROS generation test



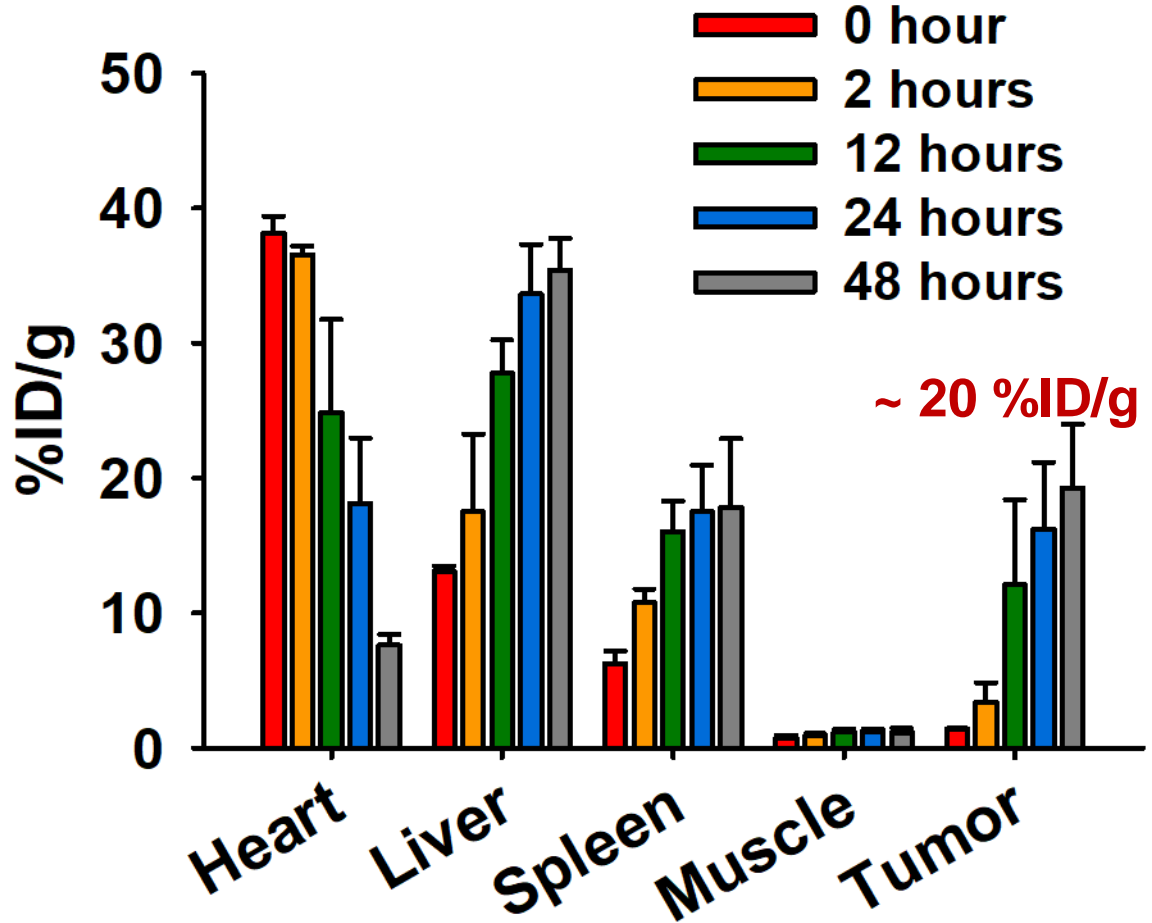
In vitro PDT test



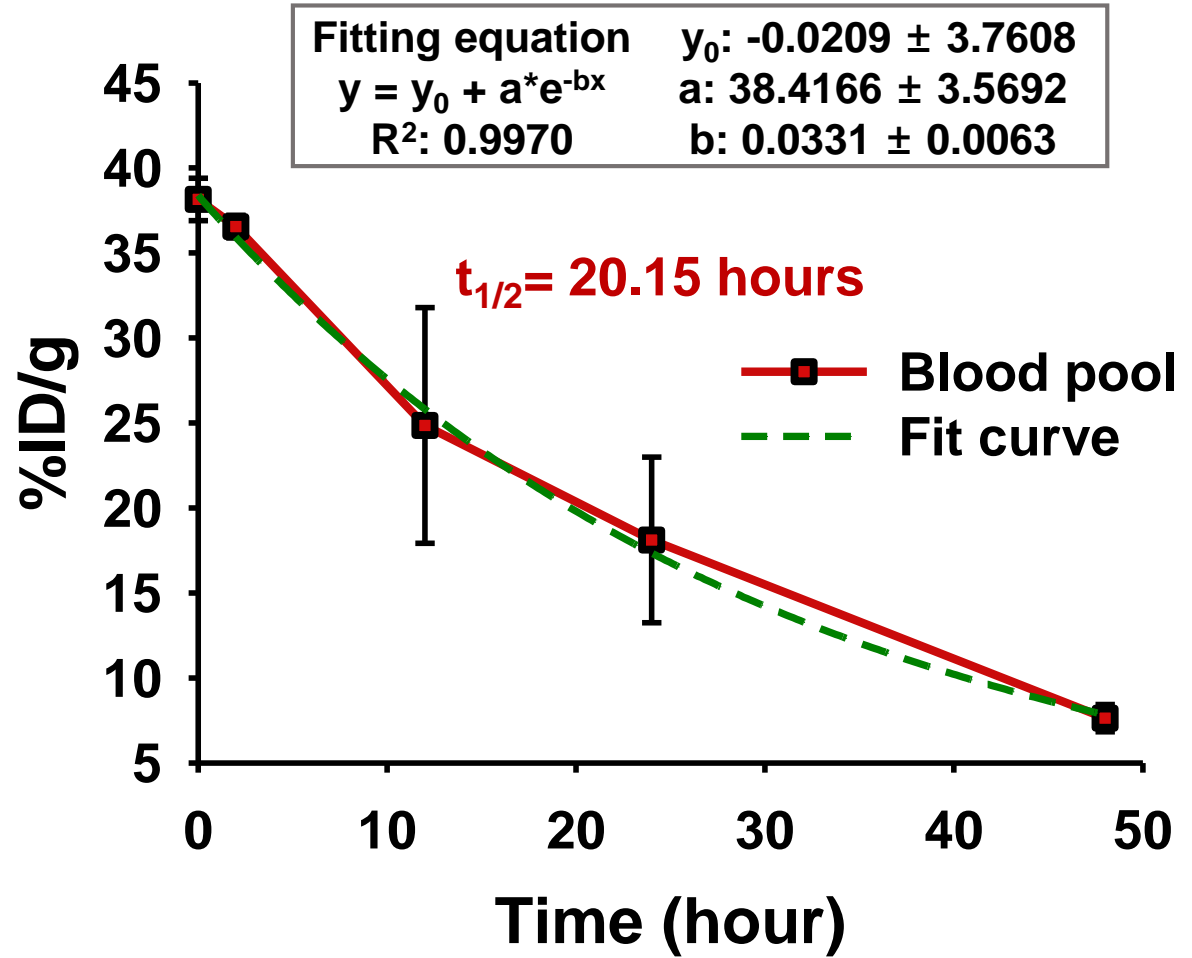
In vivo PET imaging



Quantification at different time points



Time activity curve in the blood pool



Normal saline

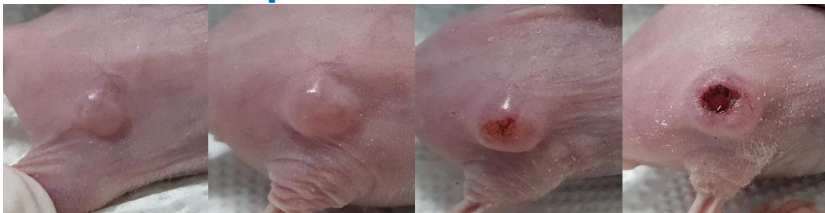
0 d 2 d 8 d 14 d



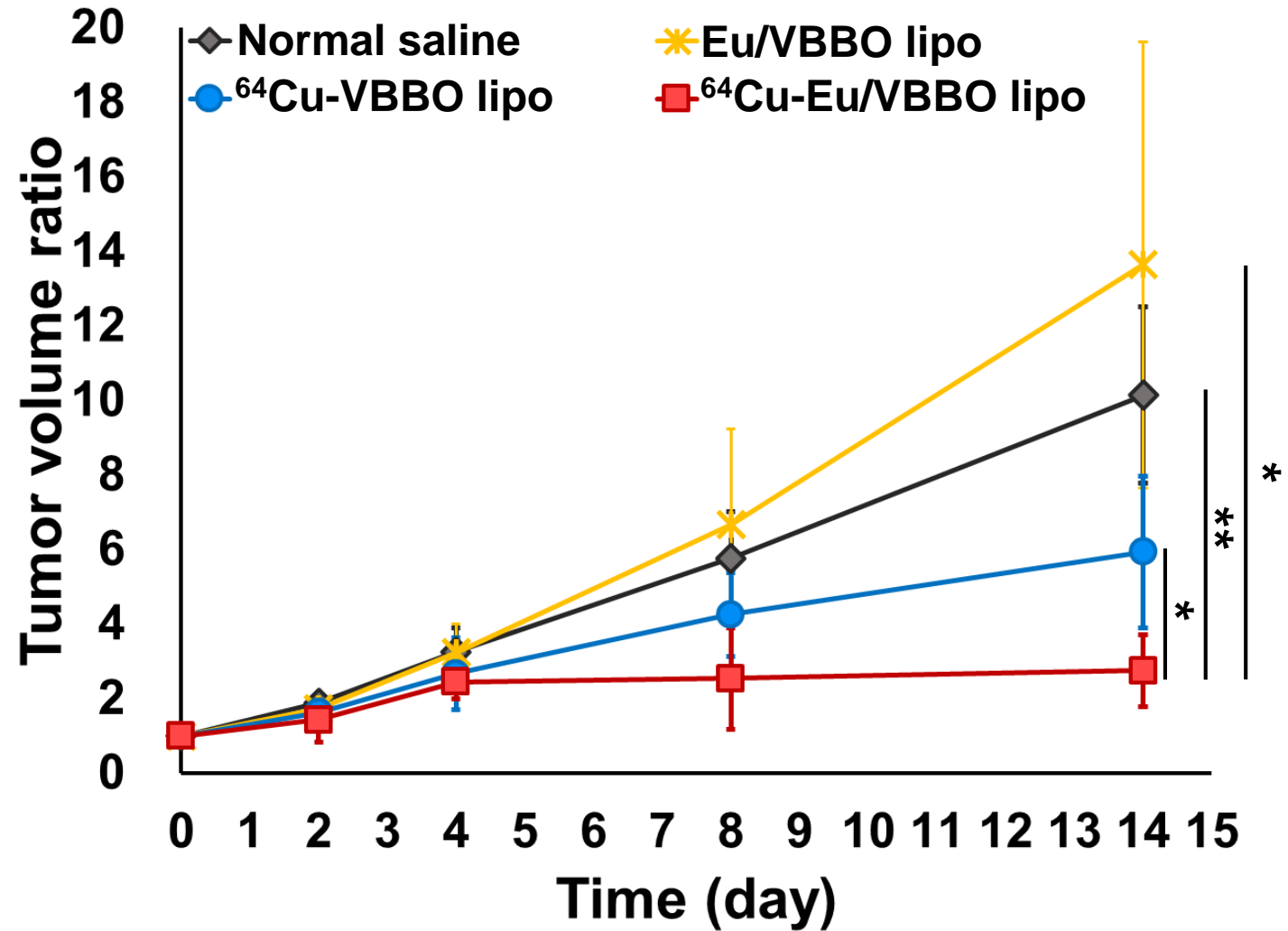
Eu/VBBO lipo



⁶⁴Cu-VBBO lipo



⁶⁴Cu-Eu/VBBO lipo

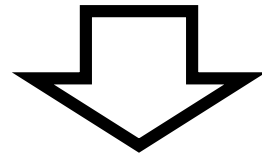


^{64}Cu -Eu/VBBO lipo : Eu / PS Loaded Theranostic Liposomal Nanoparticles for PDT

- Chelated Eu^{3+} ion and photosensitizer (PS) loaded liposome by Self-assembly method
- Long blood pool circulation ($t_{1/2} = 20.15$ hrs) and High passive targeting efficiency (~ 20 %ID/g)

^{64}Cu -Eu/VBBO lipo vs. ^{64}Cu -VBBO lipo

- RET showed higher efficiency than CLET
- Higher in vitro ROS generation and in vitro / in vivo PDT effects than ^{64}Cu -VBBO-lipo (based on CLET)



**^{64}Cu -Eu/VBBO lipo could be a promising nanomedicine for
a Novel Radioluminescence induced PDT using Radioisotope**

Acknowledgements



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Thank you for your attention



서울과학기술대학교