

Theranostic Targeted pH-sensitive Liposomes for Breast Cancer Bone Metastasis

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Controlled Release Society



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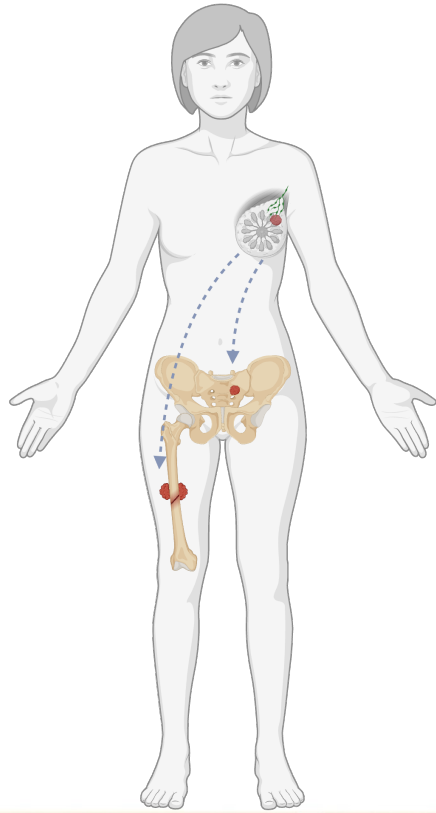
PHILADELPHIA, PA
JULY 13-18, 2025



FARMATEC

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Breast cancer bone metastasis



- Most women who die from breast cancer are in the **metastatic** stage
- Up to **70%** of those cases affects **the bones**

Bone metastasis is difficult to treat



Chemotherapy poor distribution to the bones

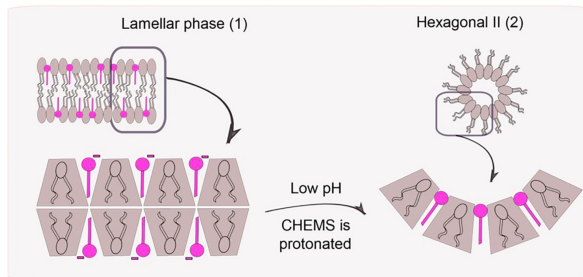
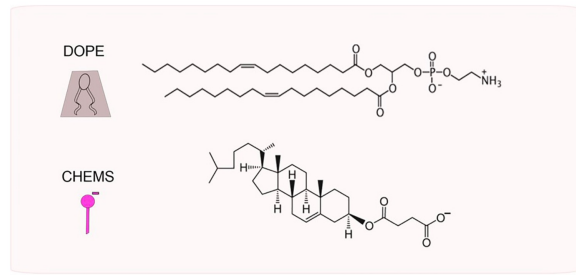


Limited efficacy + side effects

Fang e Xu 2015; Pham et al. 2019; Salvador et al. 2019; Wang et al. 2021

PC
DOPE
CHEMS

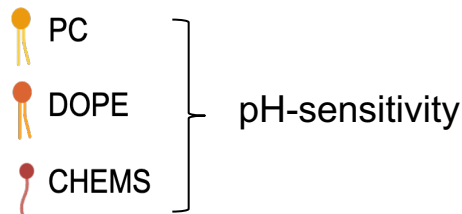
pH-sensitivity



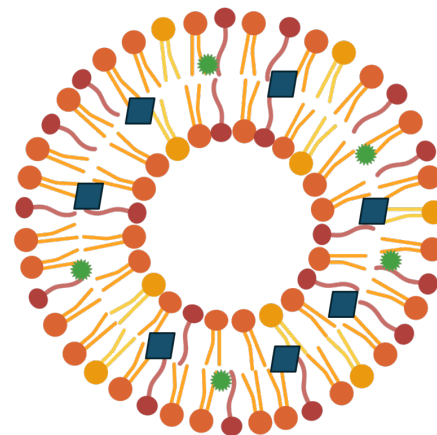
pH-sensitive liposome

Franco et al., 2021

Theranostic properties were added

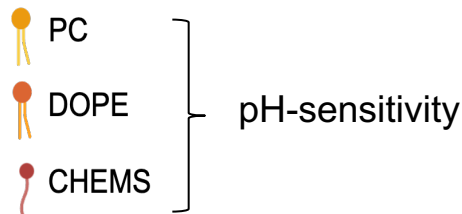


- PTX → Antitumoral effect
- IR780 → Fluorescence imaging



**pH sensitive liposomes entrapping
PTX and IR780**

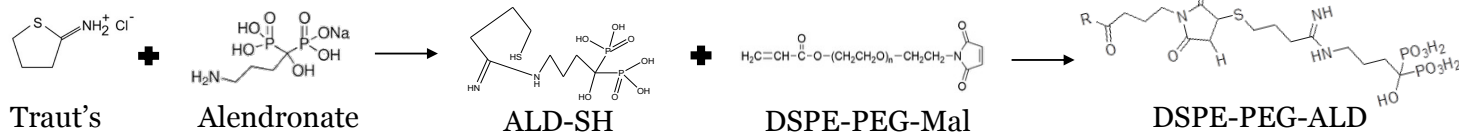
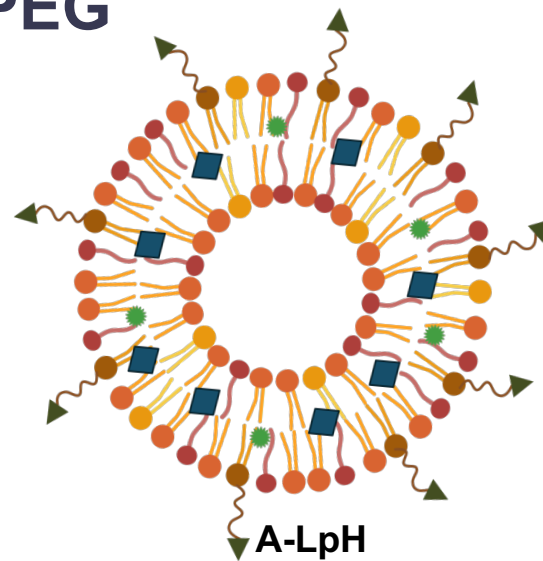
And Alendronate conjugated to PEG



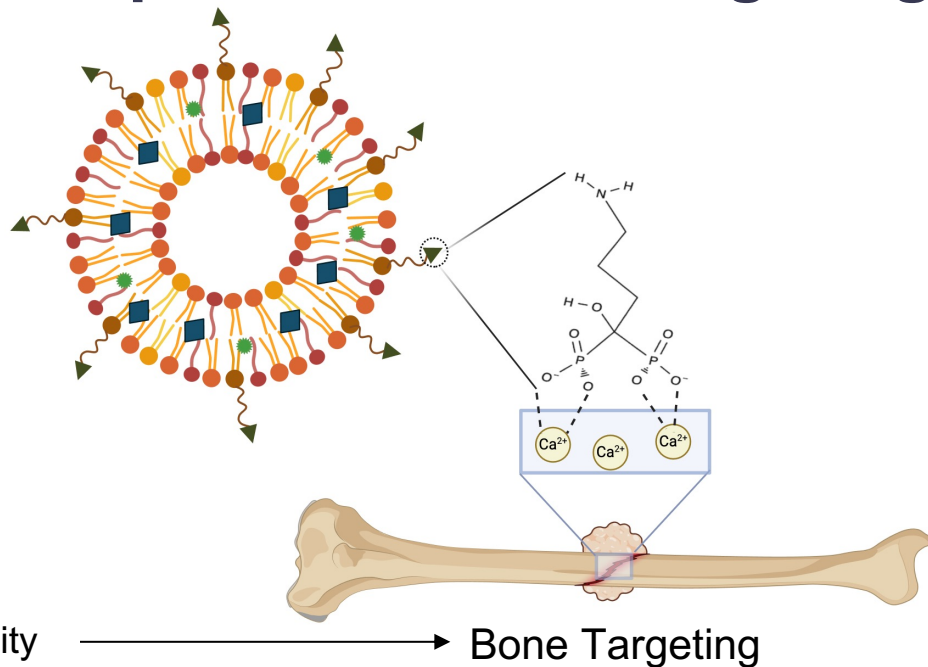
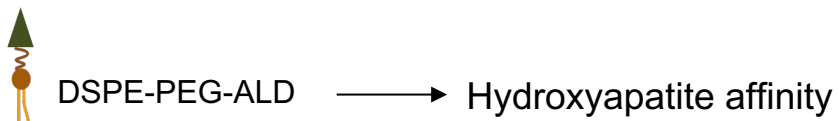
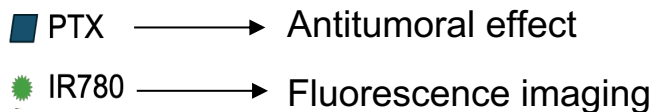
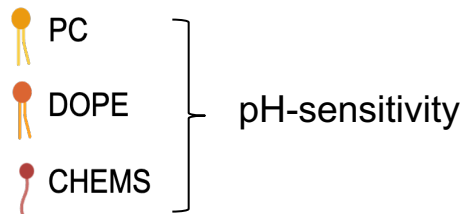
 PTX $\longrightarrow$ Antitumoral effect

 IR780 $\longrightarrow$ Fluorescence imaging

 DSPE-PEG-ALD $\longrightarrow$ Hydroxyapatite affinity



To promote Bone Targeting!



A-LpH were prepared and characterized

1-Lipid film under nitrogen pressure

2- Hydration with Hepes buffer pH 8.2

3- probe sonication (3 min)

4- incubation with DSPE-PEG-ALD 6h

Liposomes
A-LpH

Enough PTX and IR780 for treatment and imaging

Concentration
($\mu\text{g/mL}$, $n=3$)

PTX 486 ± 67

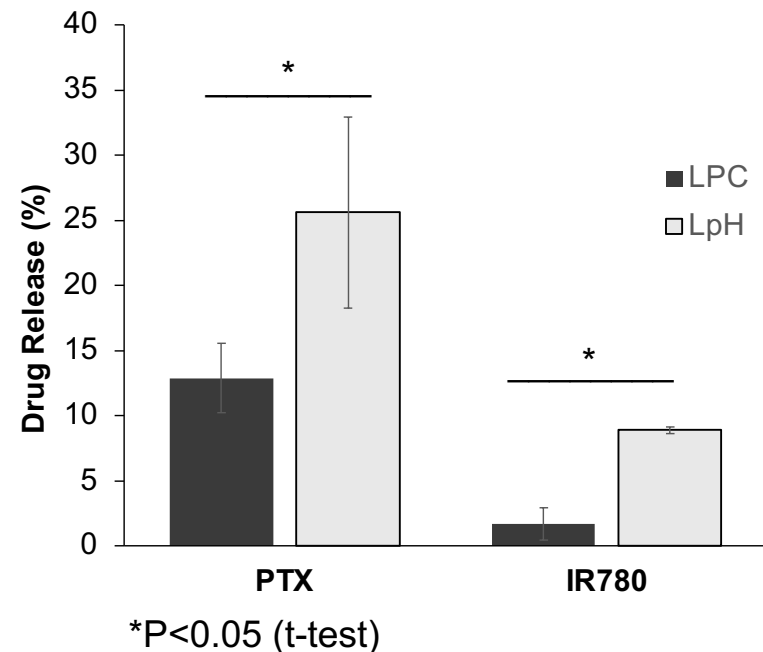
IR780 53 ± 11

PC + DOPE +
CHEMS + PTX
+IR780

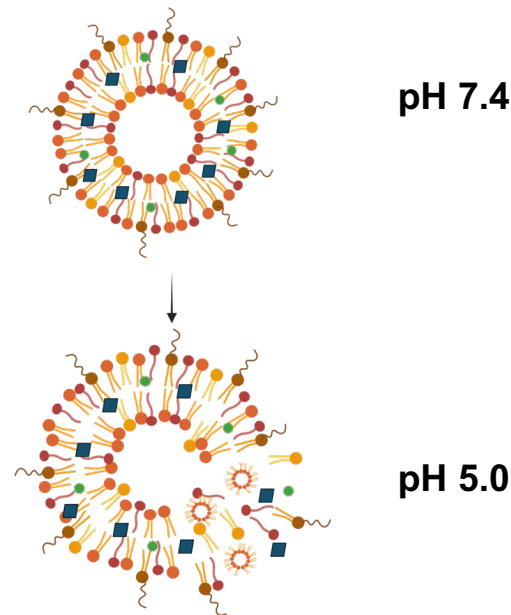
130 nm

Data under review for publication. Please do not share.

pH-sensitive liposomes release their content upon pH switch



Schematic representation of liposome bilayer disruption after pH switch

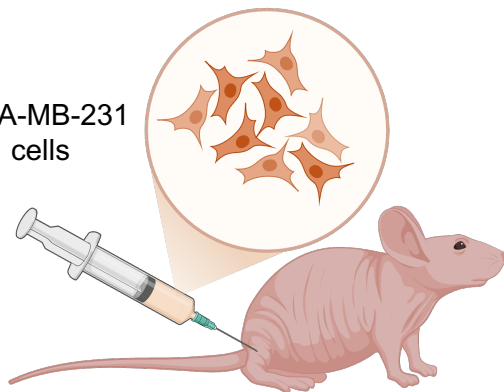


Data under review for publication. Please do not share.

Are A-LpH liposomes able to target bones affected by breast cancer metastasis?

Nude mice bearing bone metastasis in their right tibias

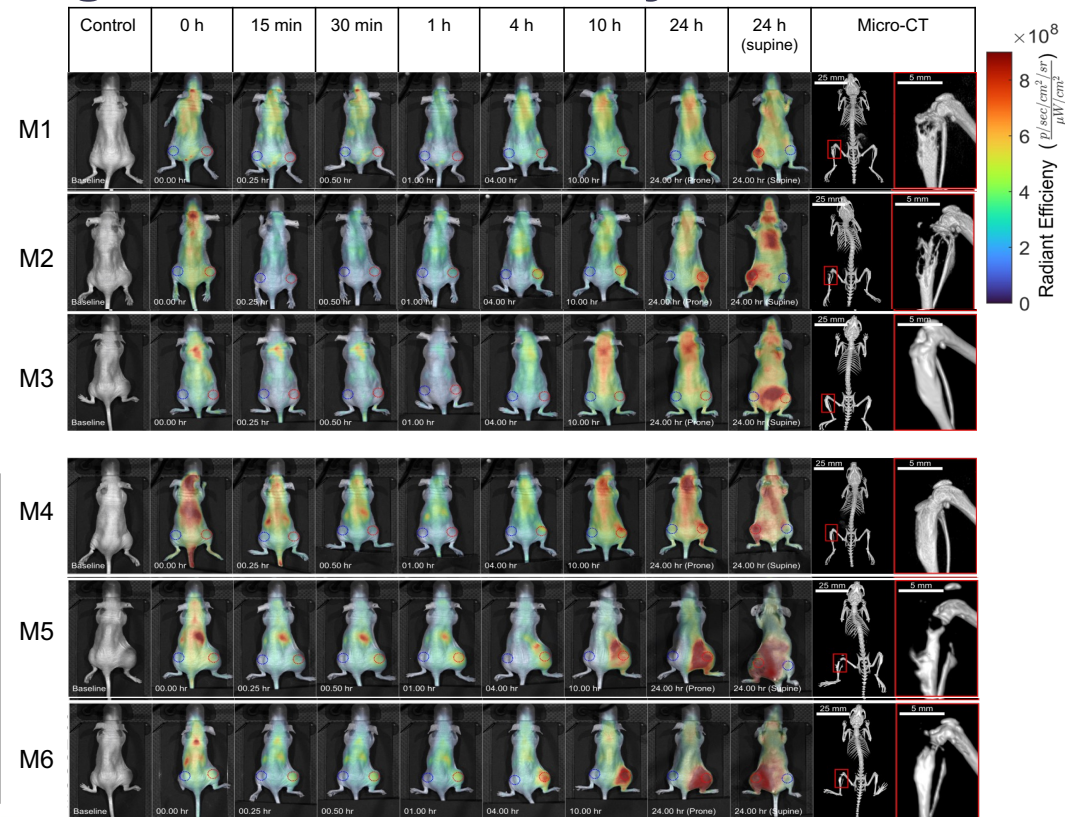
MDA-MB-231 cells



Data under review for publication. Please do not share.

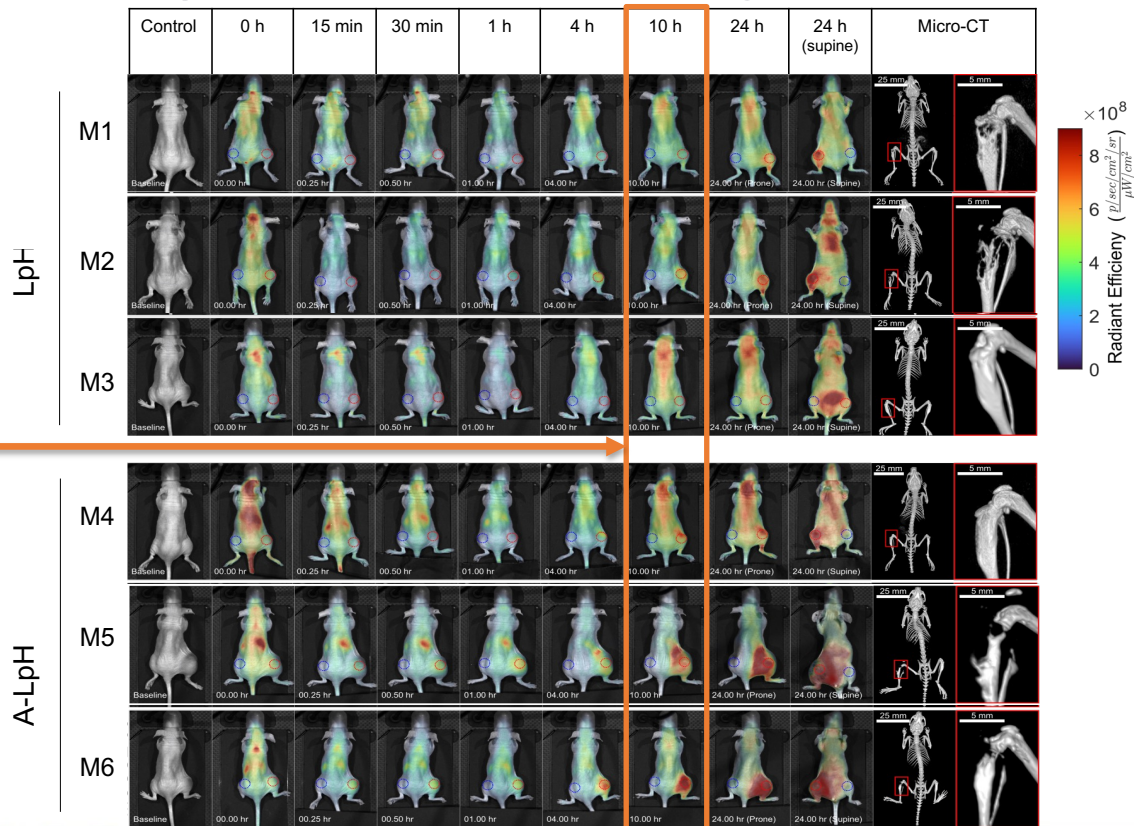
LpH

A-LpH



Are A-LpH liposomes able to target bones affected by breast cancer metastasis?

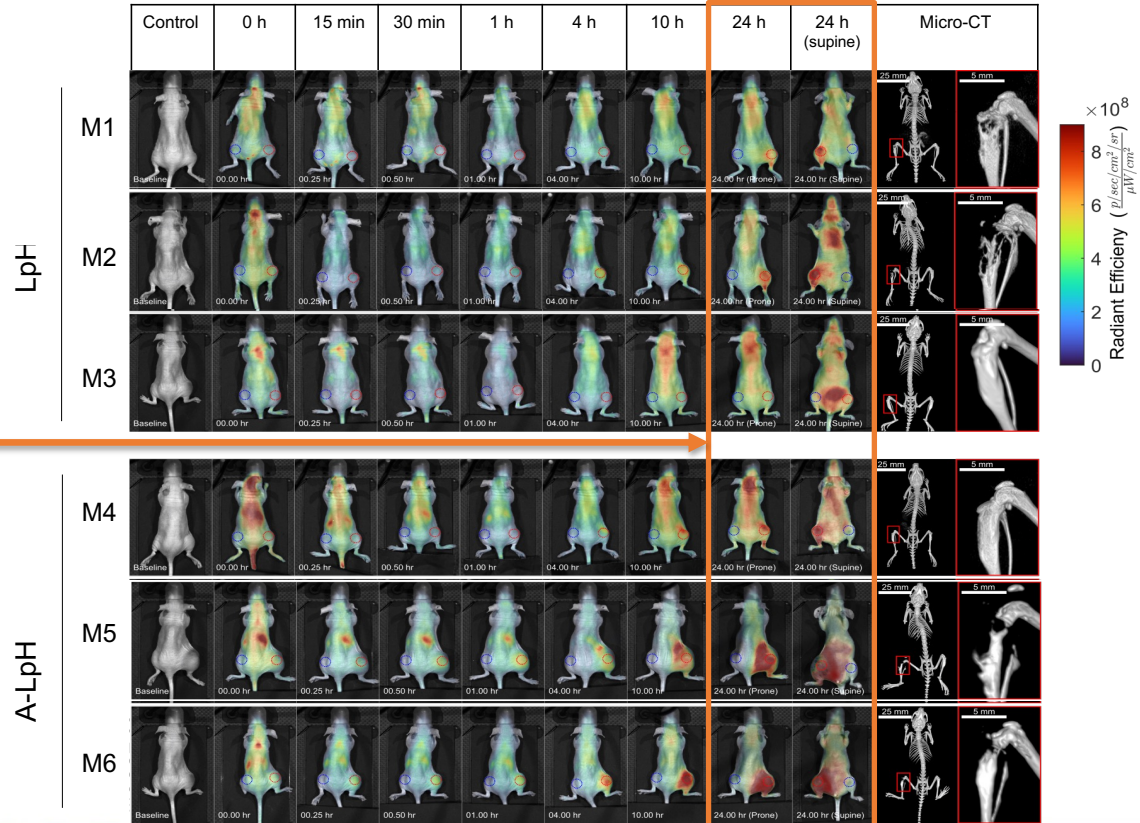
After 10 hours, A-LpHN liposomes begin to accumulate



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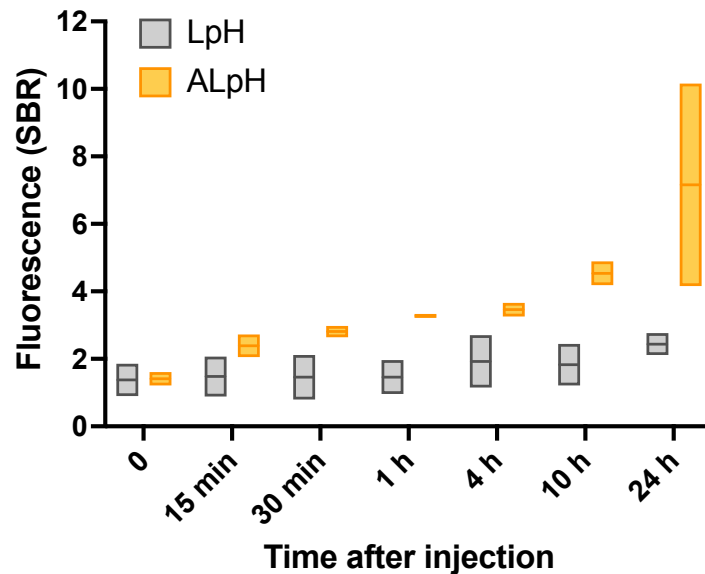
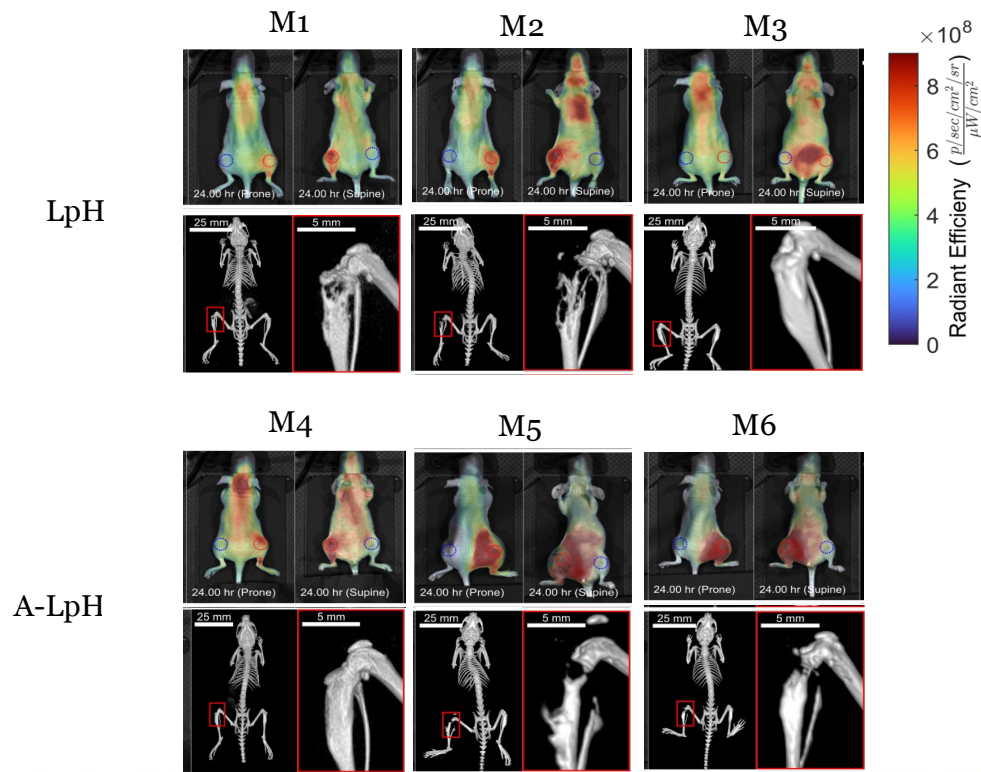
Are A-LpH liposomes able to target bones affected by breast cancer metastasis?

Most intense signal at 24 hours



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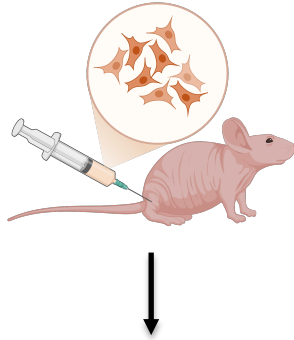
A-LpH liposomes accumulate in tumor-bearing bones



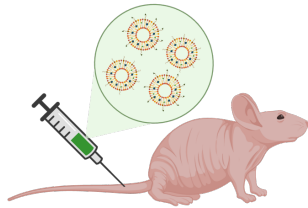
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Proof-of-concept studies indicate that A-LpH could prevent bone deterioration and metastasis to other sites

Inoculation of tumor cells



Treatment after 8 days

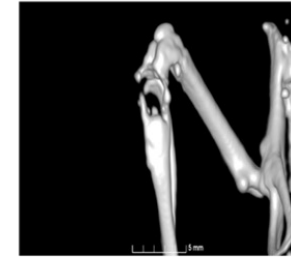
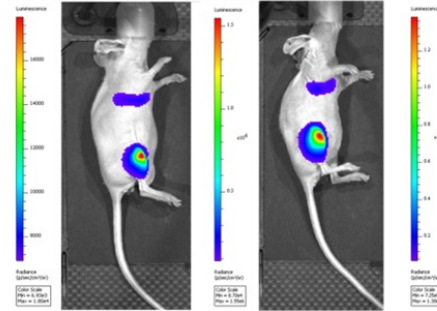


14 days

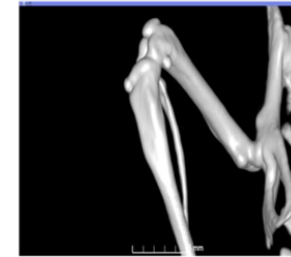
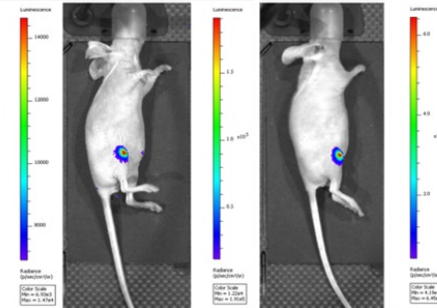
21 days

Micro-CT

Saline



A-LpH



Data under review for publication. Please do not share.

Conclusions

- ✓ Liposomes presented high drug loading and were pH sensitive
- ✓ Labeling of liposomes with IR780 allowed imaging of the biodistribution of the liposomes
- ✓ Multifunctional liposomes accumulated in the bone area affected by metastasis and show potential theranostic applications

This research shows how the versatility of liposomes can be explored to obtain sophisticated, multifunctional drug nanocarriers to target, diagnose and treat diseases considered incurable such as bone metastasis of breast cancer.

Acknowledgements

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Dr. Yichen Fang



Controlled Release Society



Brazilian Local Chapter

Any questions or would like to collaborate? Please contact: amandaclaudiaamorim@gmail.com



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