Computational Modeling of HIFU mediated Targeted Drug Delivery

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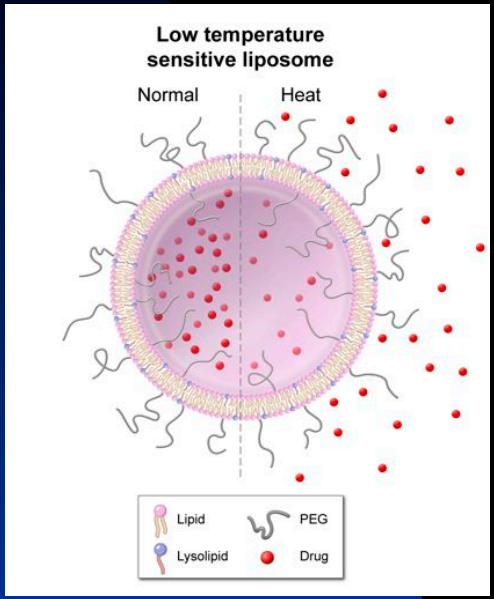
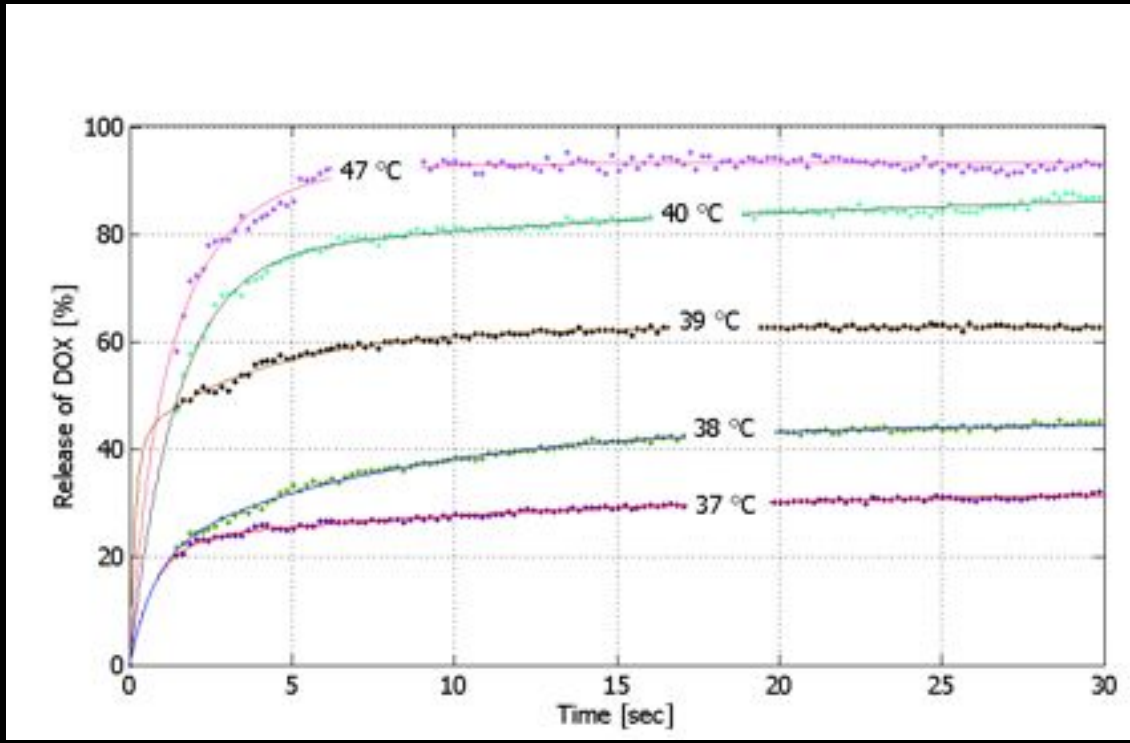
Disclosures

- none

Low-Temperature Sensitive Liposomes (LTSL)

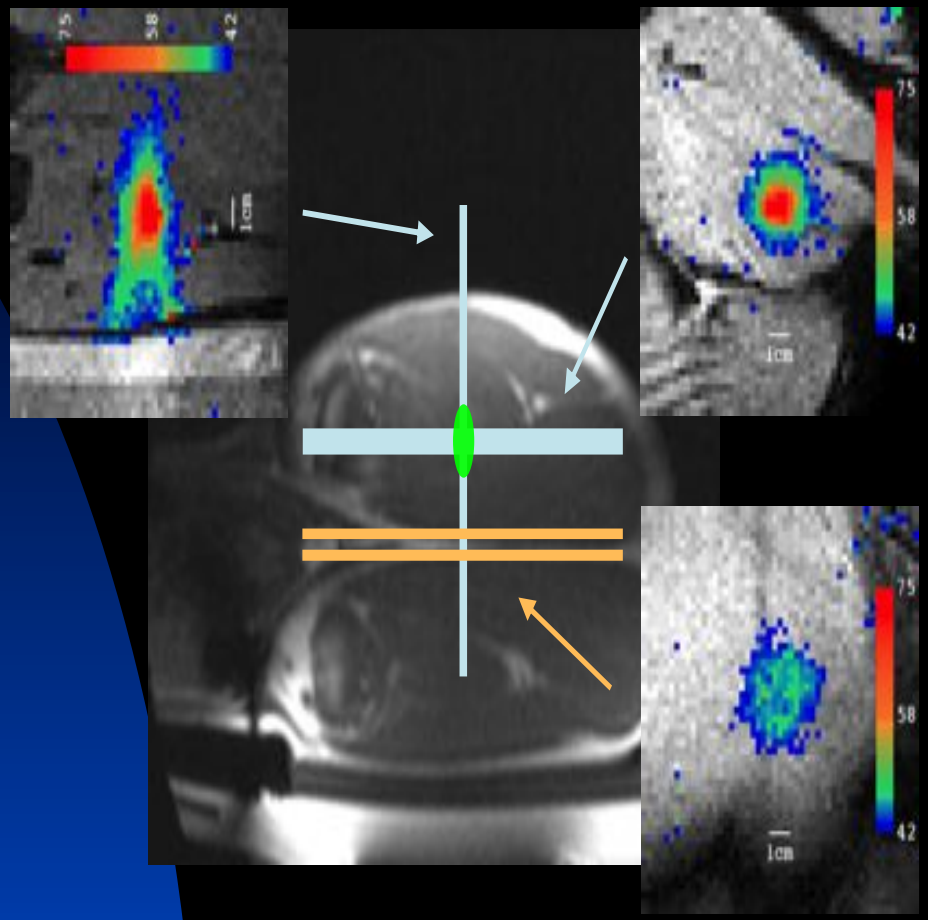


Drug release (Doxorubicin) at hyperthermic temperatures



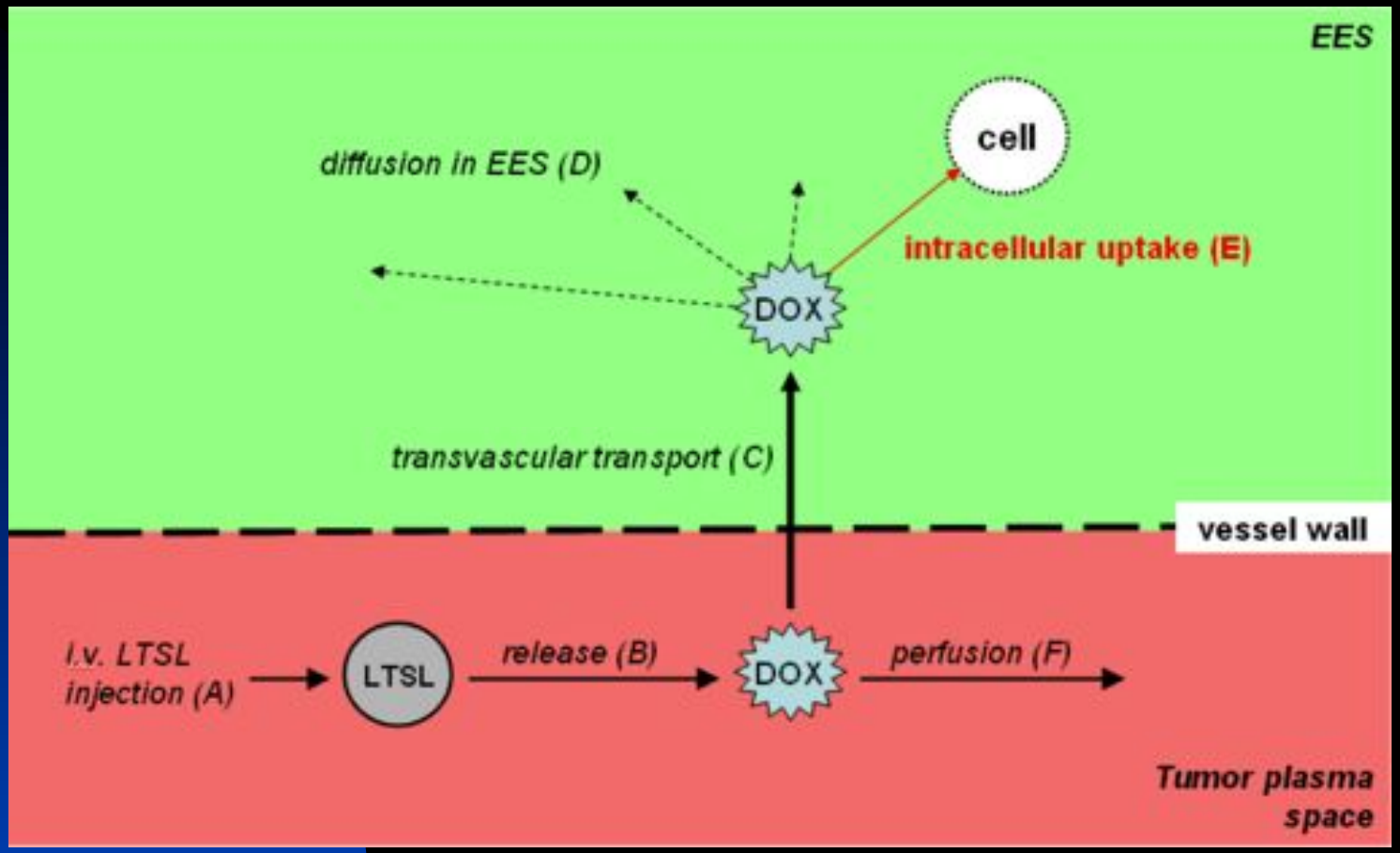
Doxorubicin Release from LTSL
(*from Gasselhuber et al., IJH 2010*)

MR guided HIFU



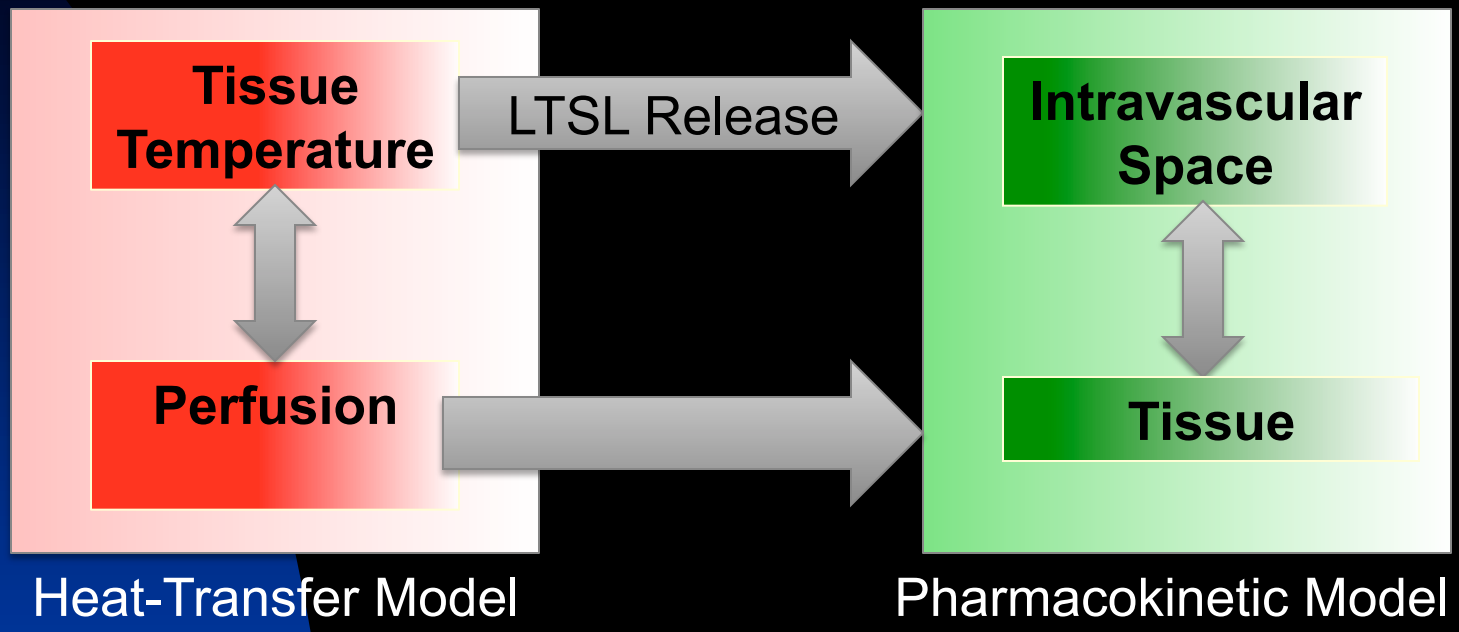
Tissue temperature profile

Drug Delivery Model



(*see also Gasselhuber et al., IJH 2010*)

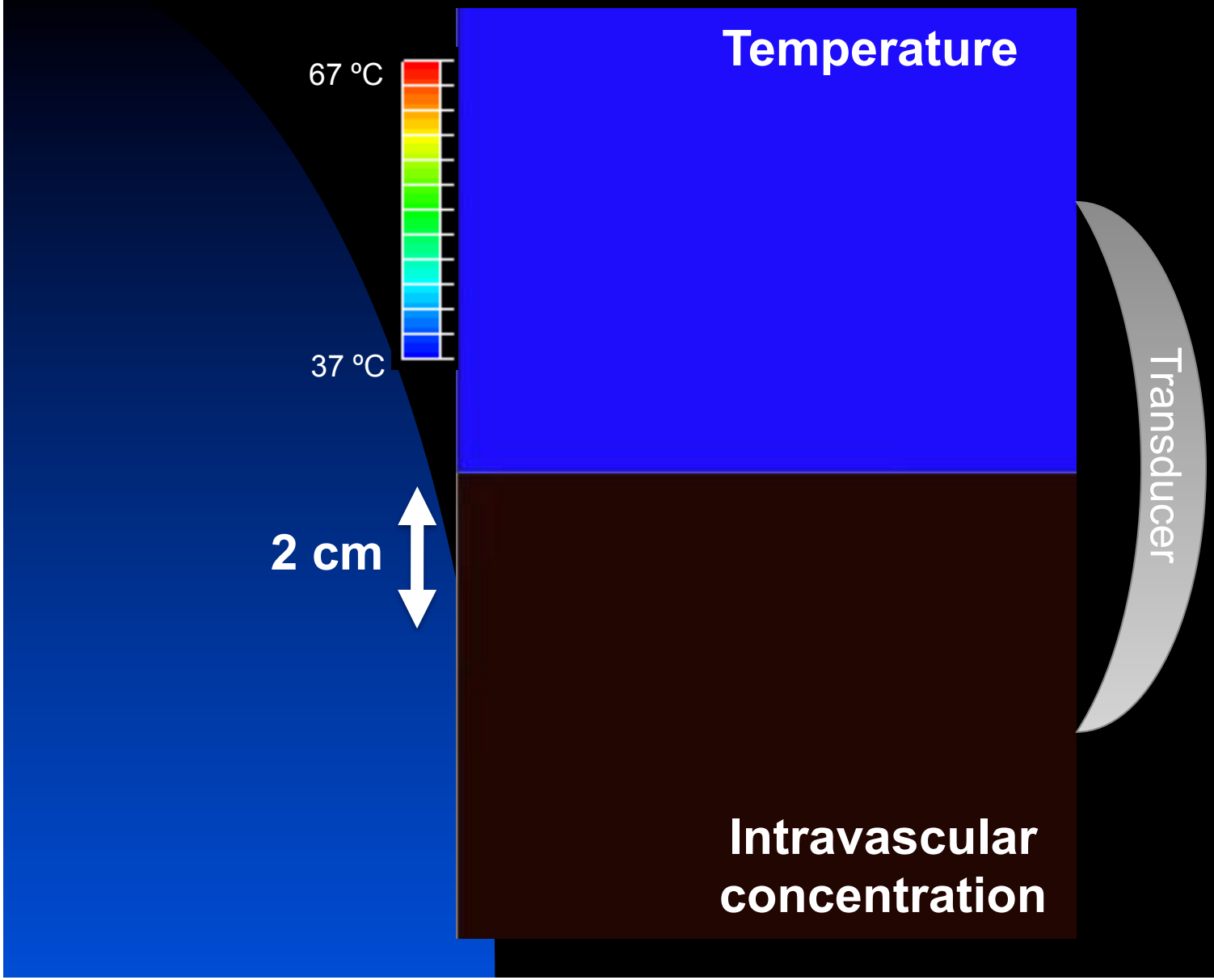
Computer Model: HIFU + LTSL



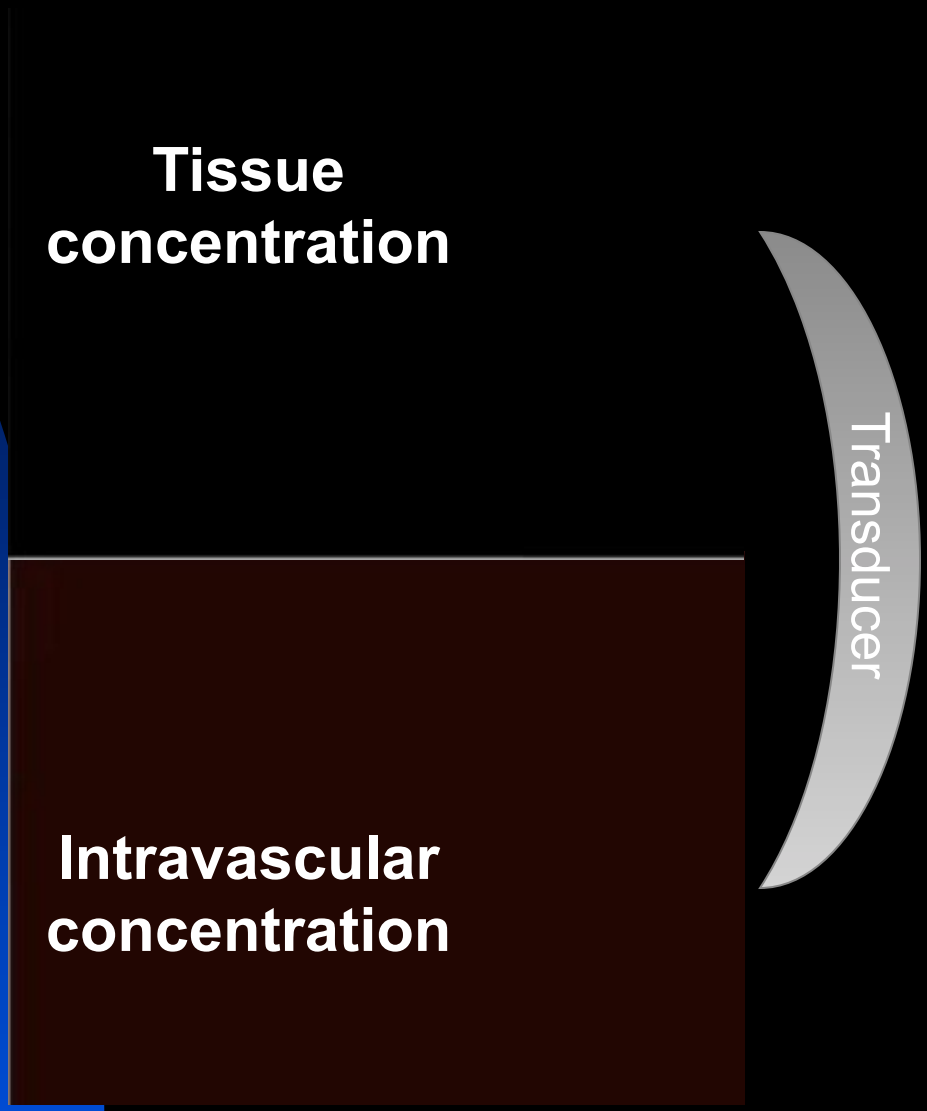
Simulation

- Bolus injection of LTSL
- HIFU for 25 s, or 10 min
  - 42 ºC, or 58 ºC target temperature

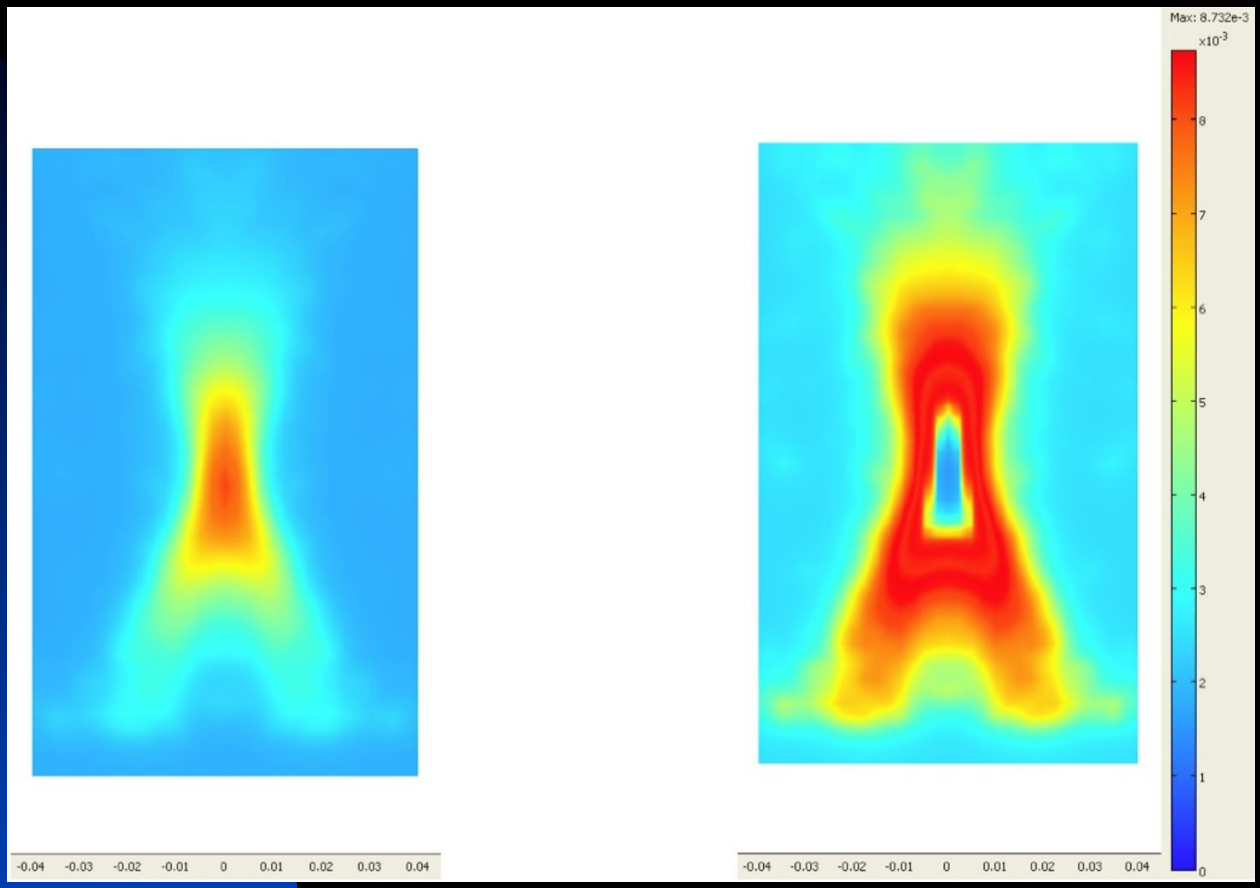
Targeted Drug Delivery: HIFU + LTSL



Targeted Drug Delivery: HIFU + LTSL

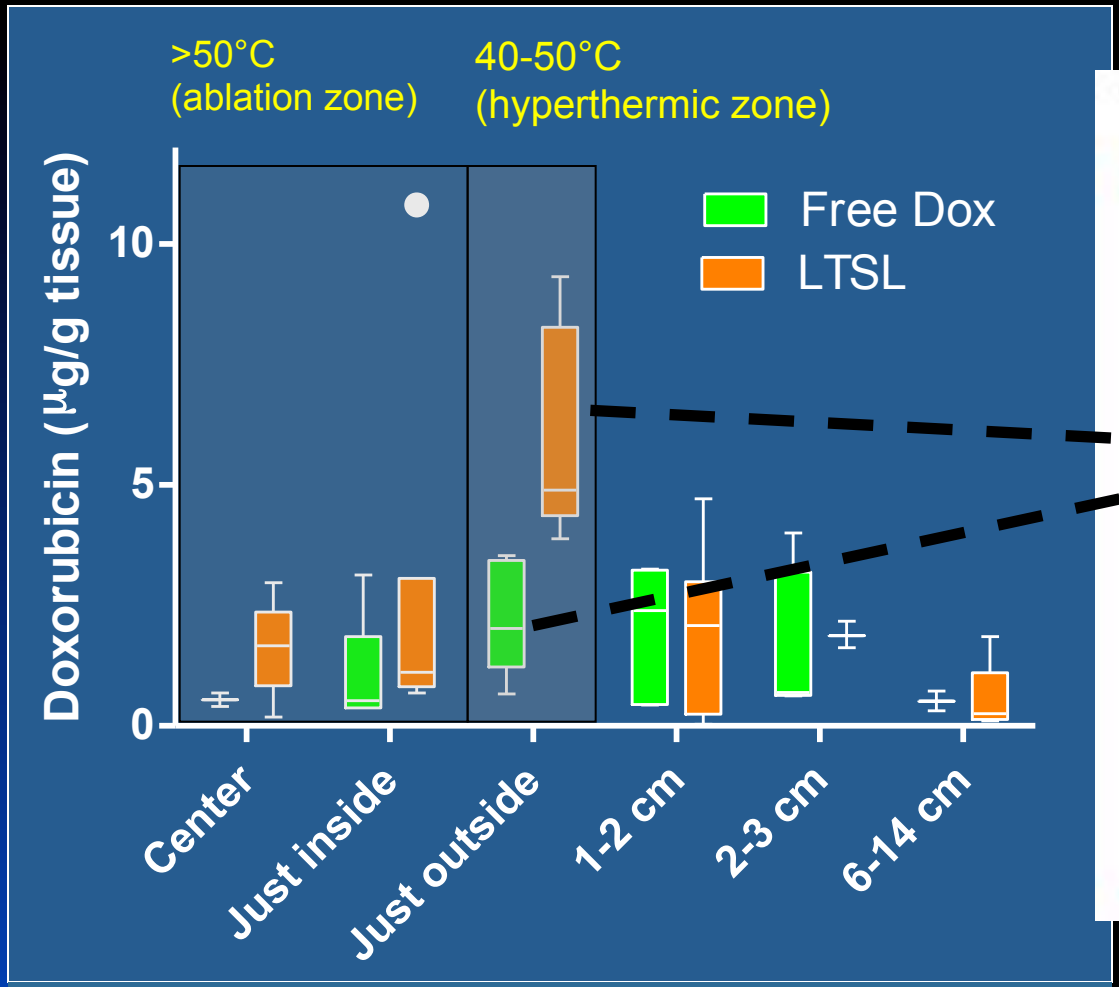


10 min heating, HT vs. Ablation



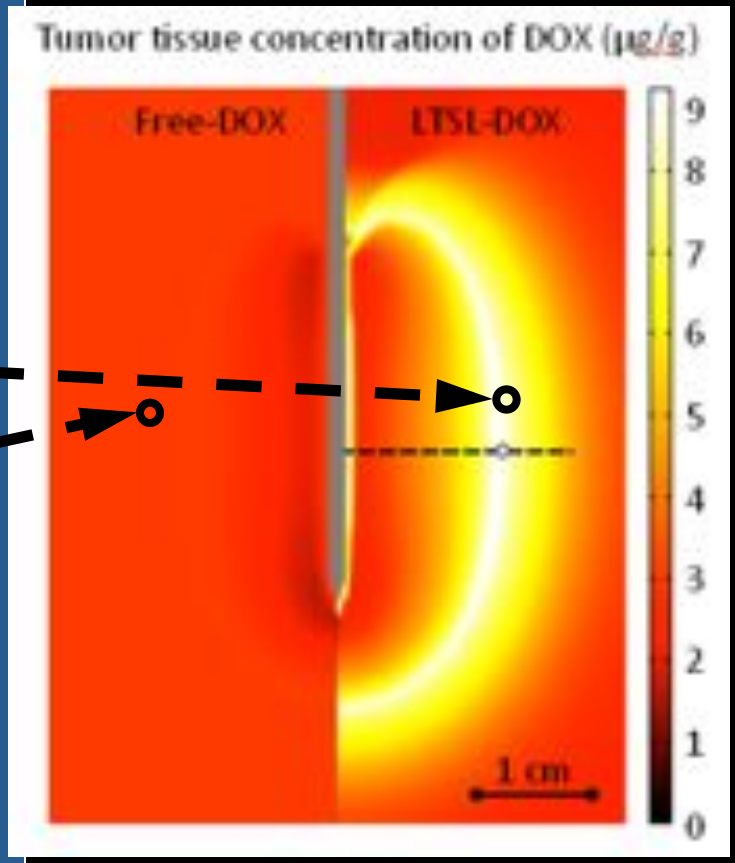
42 ºC (left) vs. 58 ºC (right)

Validation with in-vivo data



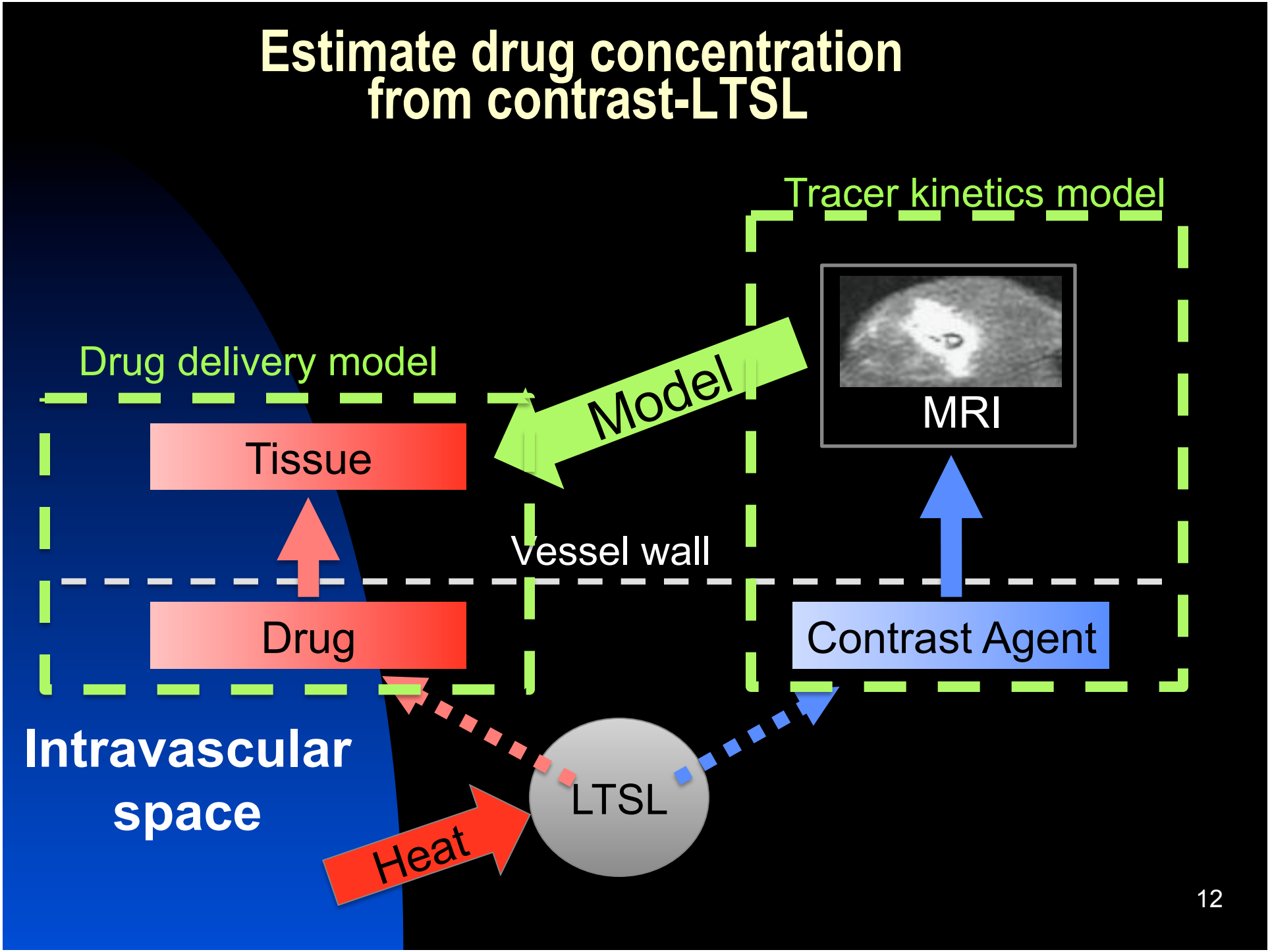
In-vivo Animal Study Results (Porcine Model)

Courtesy of Brad Wood



(from Gasselhuber et al., Int J Hyperthermia 2010)

Estimate drug concentration from contrast-LTSL



Summary

- MR-guided HIFU + LTSL -> targeted drug delivery
- Computer simulation allows optimization of heating regimen (time, temperature, etc)
- LTSL + Contrast + Drug delivery modeling
  - Visualization of drug delivery
  - Estimation of local tissue drug levels