CFDose: personalized dosimetry for liver radioembolization

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Transarterial radioembolization (TARE) with yttrium 90

First Y-90 PET/CT UCD 2017
Normal tissue activity → extratumoral microsphere deposition
Transarterial radioembolization (TARE) with yttrium 90

dose prediction: where to inject? how much?

First Y-90 PET/CT UCD 2017
Normal tissue activity → extra tumoral microsphere deposition

dose verification: how did we do? how much dose?
CFDose for Personalized 3D dosimetry with CFD

Planning CBCT

Meshing
Blood fluid properties
Boundary conditions
Flow Simulation: Multiscale Modeling

- Segmented branches > terminal arterioles

→ Segmented arterial tree combined with RCR Windkessel model for arterioles

- RCR circuit tuned using whole-body 0D model
Flow Simulation: Multiscale Modeling

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Blood Flow and Microsphere Distribution

- Lobar injection: segments received 5%-40%
- Selective injection: tumor received 82%

→ Tumor received 49% of microspheres after both injections

Taebi, Vu, Roncali. J. Biomech. (submitted)
Dose Kernel Calculation

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\text{Cumulative activity} \quad (\text{MBq.s})
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\[
\text{Gy / MBq.s}
\]

\[
= \quad \text{Gy}
\]

- Highly heterogenous dose distribution between segments
- Predicted total dose 125 Gy, consistent with physician reported dose with MIRD 137 Gy
Y-90 PET/CT post treatment

Absorbed dose

Clinical Y-90 PET/CT

Qualitative agreement between predicted dose and Y-90 PET measured activity

- 6 patients scanned at UC Davis since September 2017 through NCI CCSG
- Quantitative comparison of dose distribution in progress

Gustavo Costa, ITCR Poster
Conclusions

- Developed proof of concept dosimetry tool for personalized treatment planning

- Promising results, next step is validation then integration of computational tools

- Ultimate goal is a flexible tool for Interventional Radiologists to determine best injection site and activity pre-treatment based on dosimetry
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