Outlining Traditional Treatment Pathway and Time to Treatment for Y90 Radioembolization

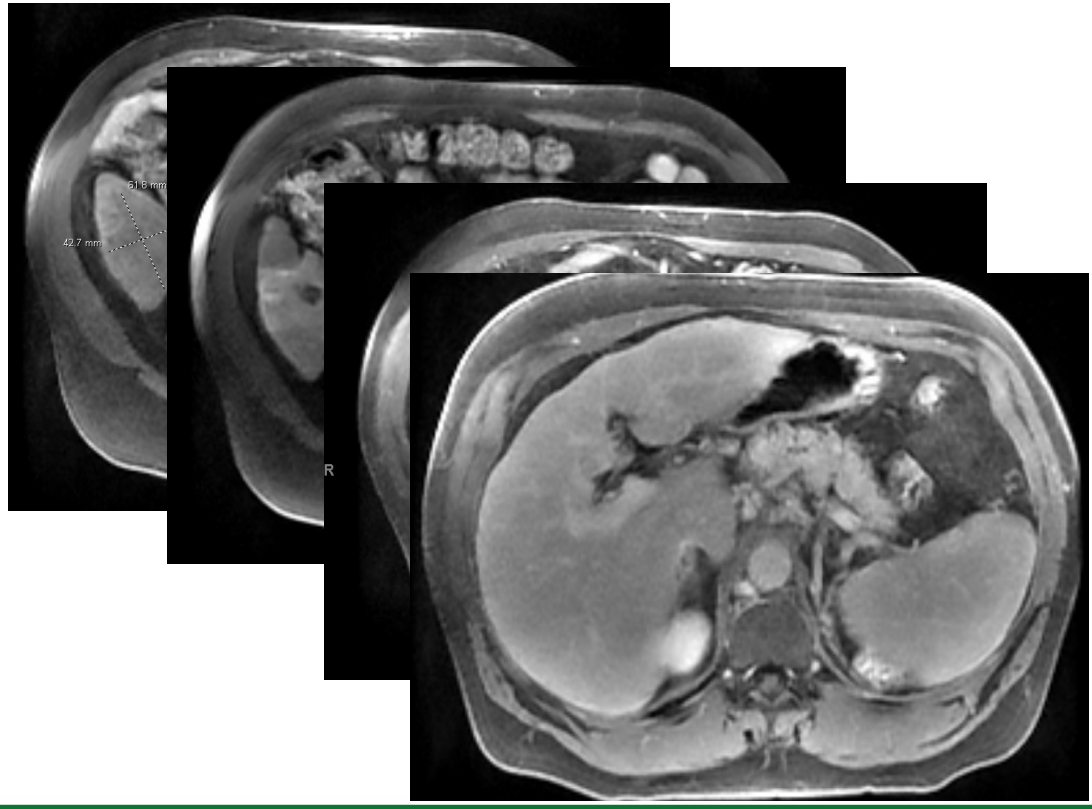
Venkatesh (Kavi) Krishnasamy, MD FCIRSE

Associate Professor of Radiology
Director of Interventional Oncology
Director of Interventional Research
University of Alabama Birmingham

CIO

Let's Start with a Case

- Imaging: Day zero
- Clinic 1 month
- 62 yo Male
- MASLD
- ALBI 2
- CP A5
- BCLC C
- ECOG 1
- AFP 5700

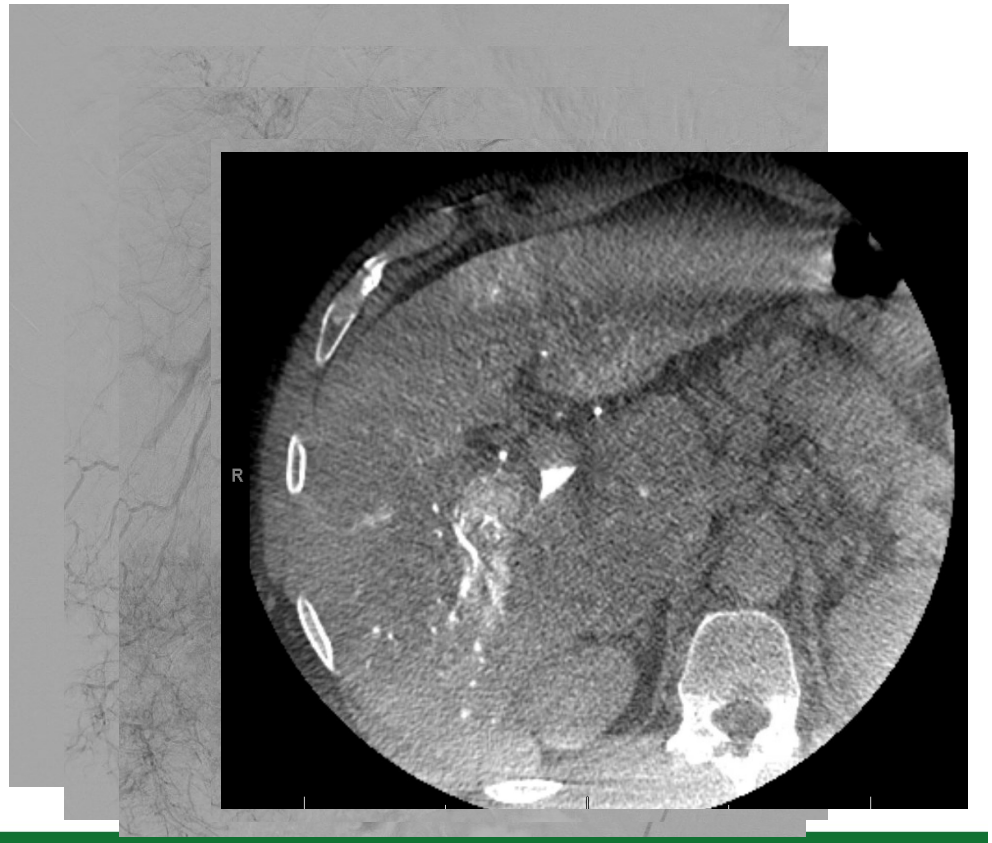


Dosing

- Mapping 1 month after clinic

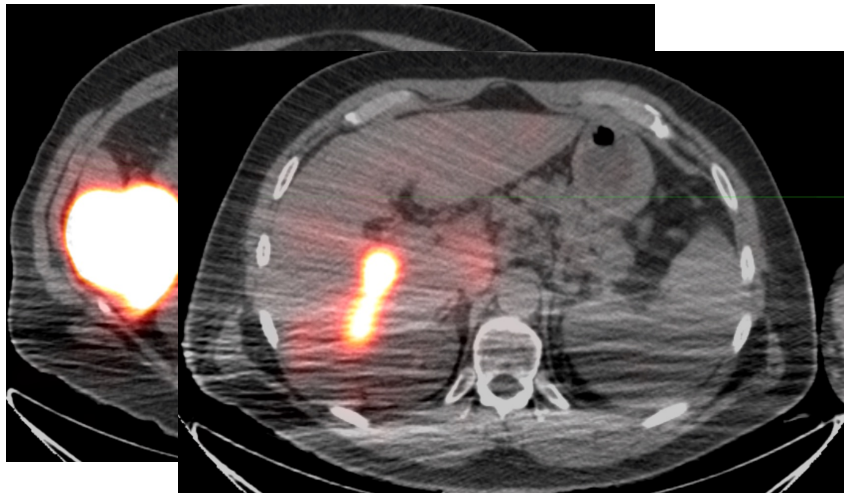
Lung Shunt and Volumes		
Lung Shunt =	3.12	%
Lungs Total Counts =	504.85	kCNTS
Liver Total Counts =	15694.3	kCNTS
Lungs Volume =	2756	cc
Liver Volume =	2356.75	cc

- Treatment 6 wks after clinic
  - First wk Tues
  - Segment 6 350cc 8gbq
    - 600gy 11gy lung
  - Segment 6 100cc 3gbq
    - 800gy 4.5gy lung
  - PVT 100cc 3gbq
    - 800gy 4.5gy lung

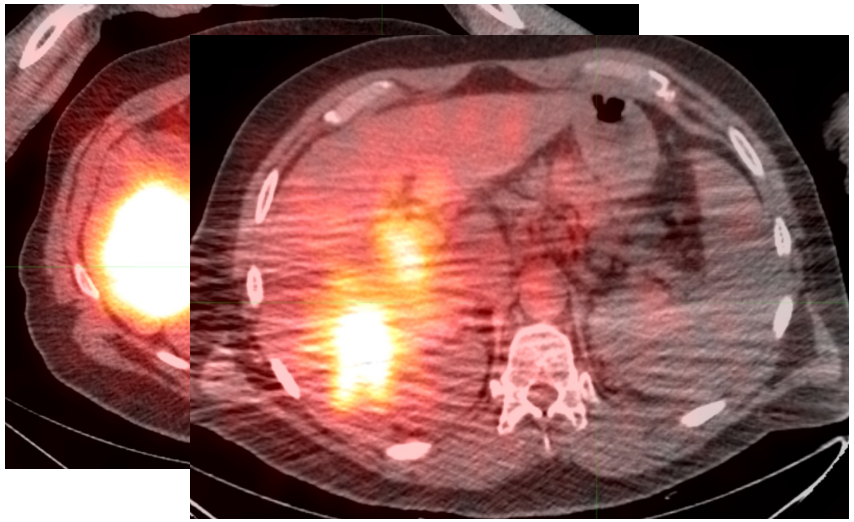


SPECT/CT

- Post MAA

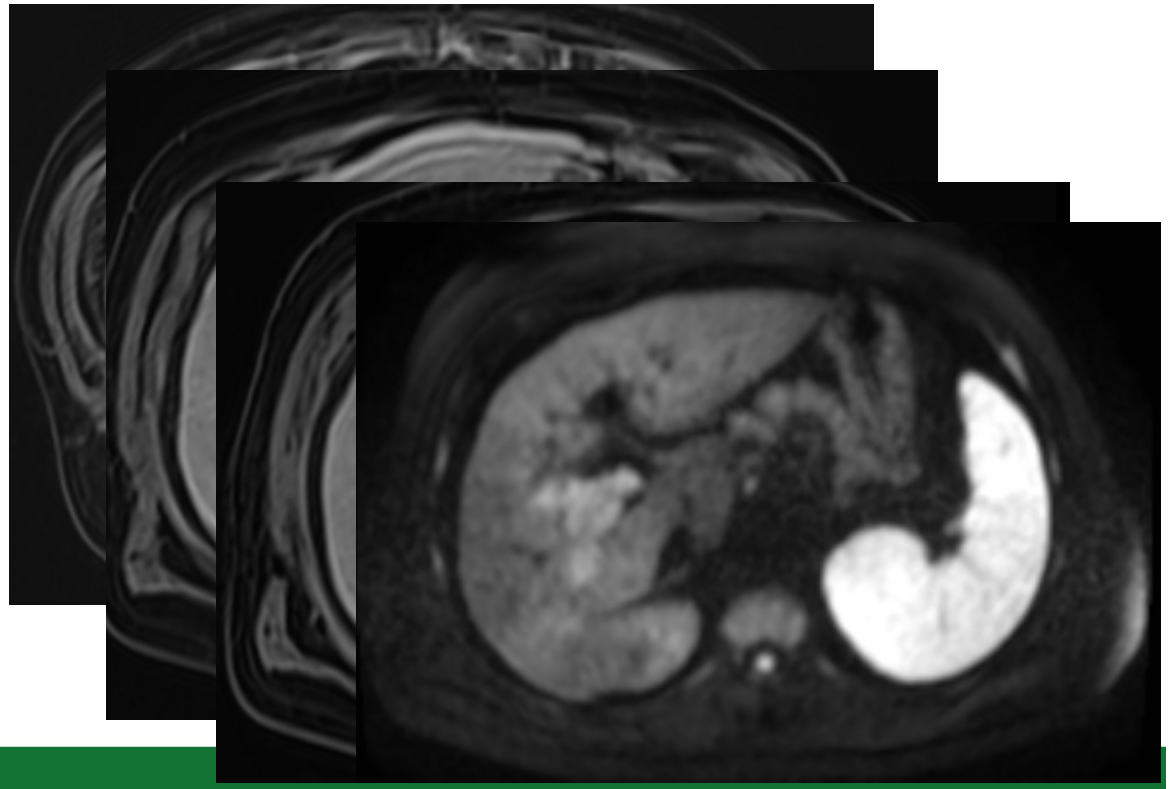


- Post Y90



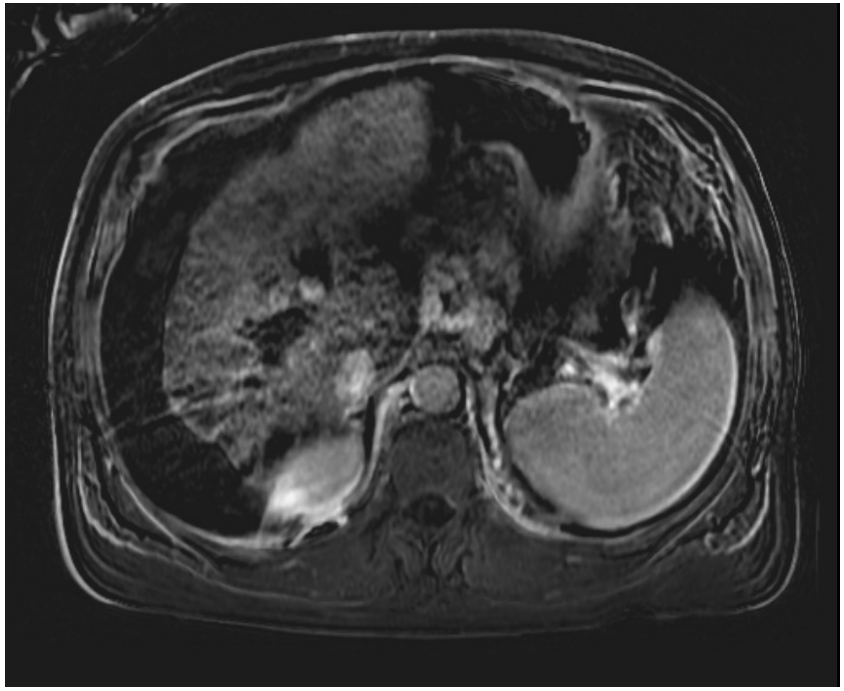
Initial Follow-Up

- 7 wks post treatment
- AFP 13,600
- CP B9
- ALBI 3

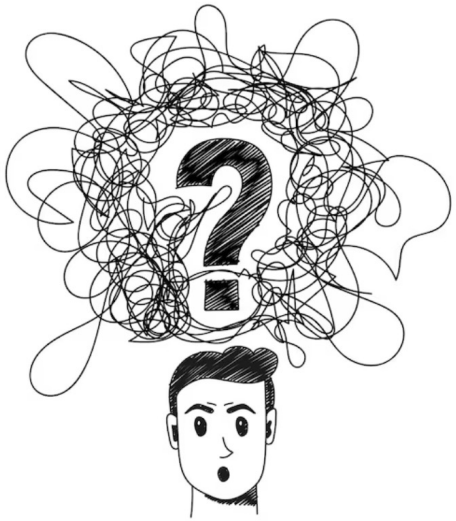


Long-Term Follow-Up

- 11 months after treatment
- AFP 350
- CP B9
- ALBI 3
- Lenvima® (lenvatinib)
- Recurrent paracentesis



Thoughts?



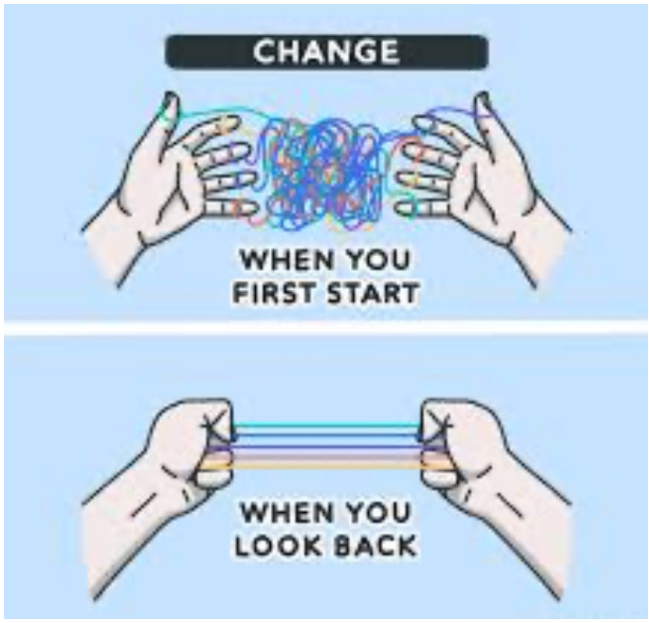
- Bad biology
- Dosimetry
  - Treatment day
  - In combo with IO

- But……..

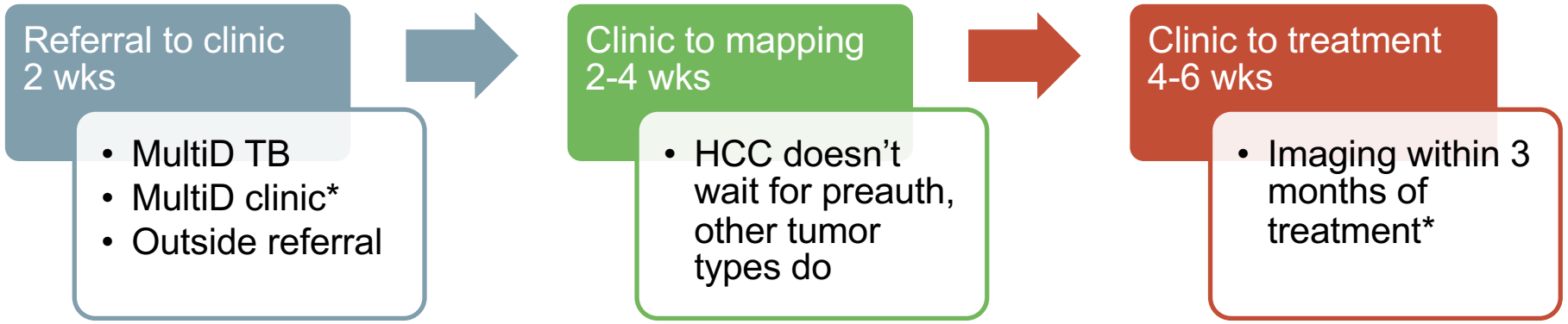
- **Treatment plans need to be individualized to the patient**

Traditional Workflow

- What was traditional is not contemporary!!!
- Not absolute
  - Treatment timeline
- But definitely for
  - Mapping
  - Dosimetry
  - Treatment
  - Follow-up



Pretreatment Workflow

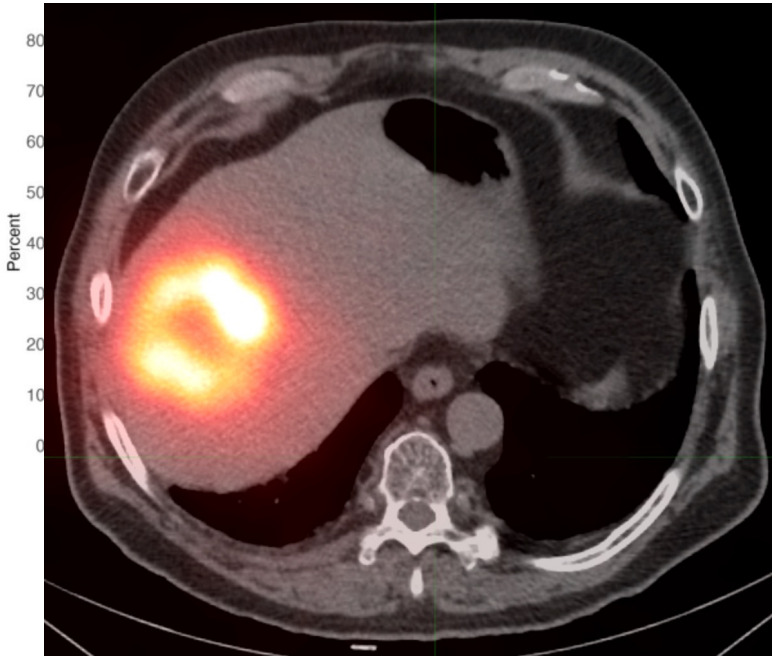


- MDTB or MTC is just the beginning of communication and collaboration
- Labs at clinic, mapping, and treatment

Weber, et al. *EJNMMI.* 2022. Mourad, et al. *Cancers*. 2024. Dahan, et al. *HC*. 2023.

Mapping Workflow

- Treatment intent
  - Curative
  - Bridging
  - Downstaging
  - Palliative
- Mapping
  - Nonselective CBCT
  - Multiple selective CBCTs
    - Every delivery spot
    - Drop the contrast rate and volume as needed
      - Volume accuracy
  - Nonselective or selective MAA

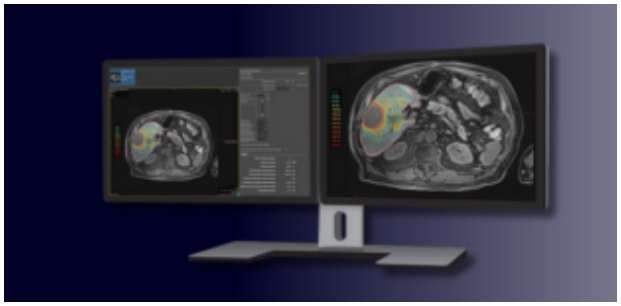


Salem, et al. *EJNMMI*. 2022.

Dosimetry Software

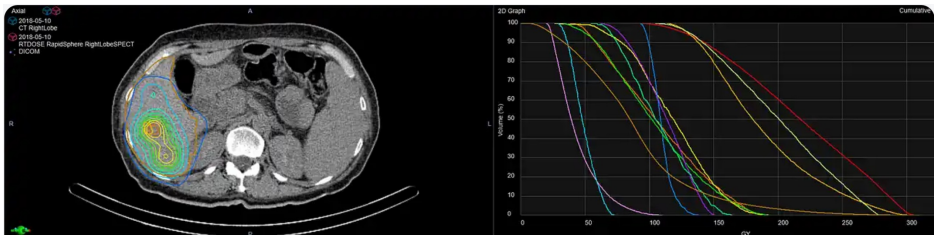
Simplicit^{90}Y™

Personalised dosimetry



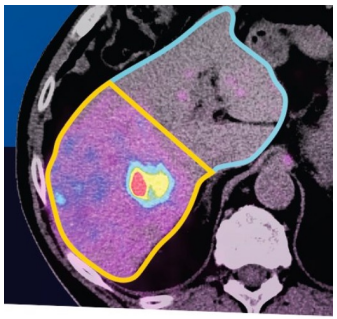
RapidSphere™

Image-guided voxel dosimetry for Y90 selective internal radiation therapy



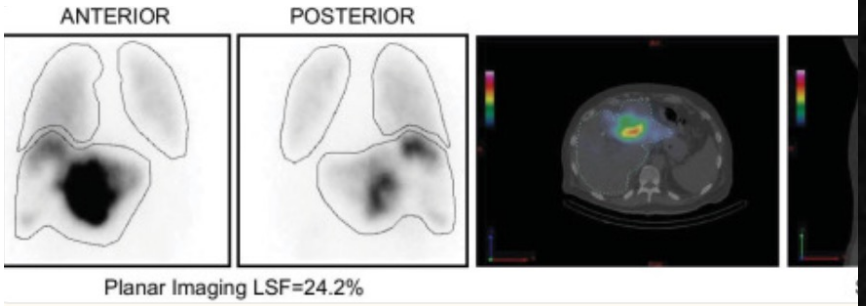
SurePlan™ LiverY90

Advanced dosimetry software for treatment of patients undergoing Y90 radioembolization



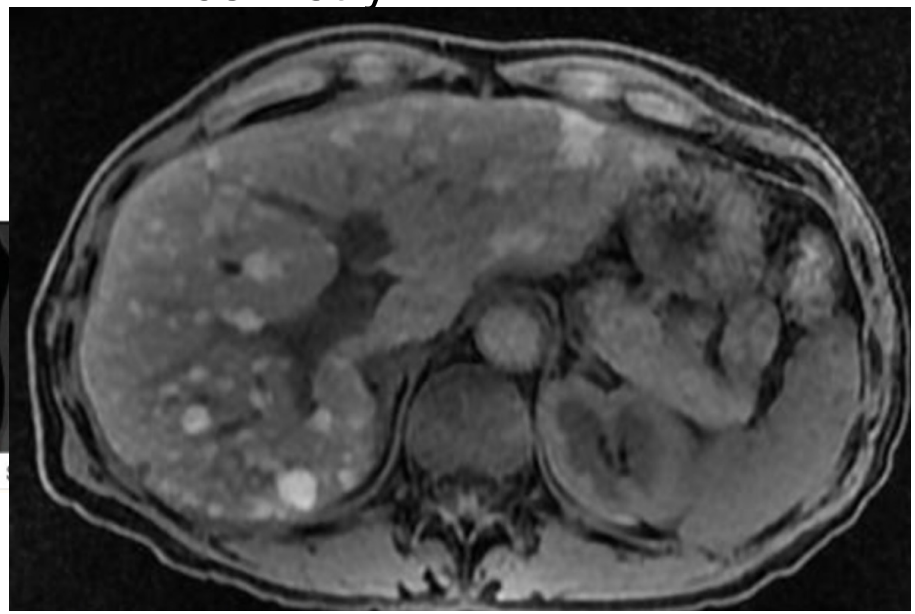
MAA Dosimetry

- Software – MIM
  - SPECT CT lung shunt
    - Especially over 10%
  - Whole liver volume



  - Perfused volumes
    - Philips workstation

- Dosimetry



Georgiou, et al. *EJNMMI*. 2021. Elsayed, et al. *CVIR*. 2021.

MAA Dosimetry

- Partition dosimetry
  - > MIRD
  - > BSA
- Be cognizant
  - MAA to Y90 disparity

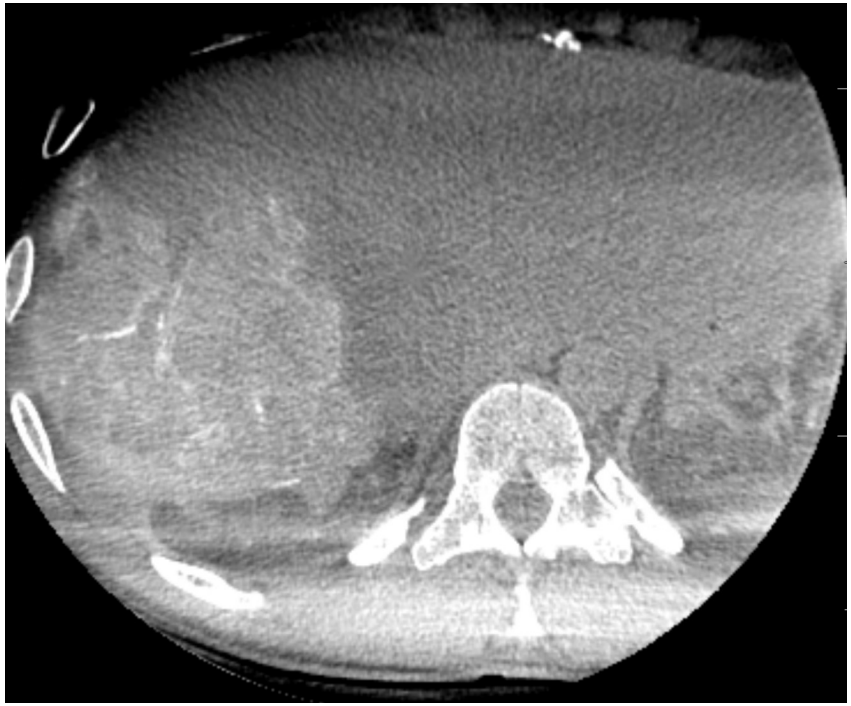
Target Region Statistics		
Liver_Perfused_Target_ Suffix =	I	Unit
Target Region Volume =	799.67	cc
Percent of Liver Outside Target Region =	29.81	%
Percent of Liver Inside Target Region =	70.19	%
Liver Volume =	1091.18	cc
Tumor Involvement =	34.7	%
All Tumors (within Target Region) Volume =	277.52	cc
Total Tumor TNR =	3.92	:1
Tumor 1 (within Target Region) Volume =	173	cc
TNR Tumor 1 =	4.75	:1
Tumor 2 (within Target Region) Volume =	7.44	cc
TNR Tumor 2 =	1.06	:1
Tumor 3 (within Target Region) Volume =	97.08	cc
TNR Tumor 3 =	2.67	:1

Target Region Statistics		
Liver_Perfused_Target_ Suffix =	I	Unit
Target Region Volume =	792.14	cc
Percent of Liver Outside Target Region =	33.25	%
Percent of Liver Inside Target Region =	66.75	%
Liver Volume =	1101.37	cc
Tumor Involvement =	42.35	%
All Tumors (within Target Region) Volume =	335.45	cc
Total Tumor TNR =	1.82	:1
Tumor 1 (within Target Region) Volume =	208.74	cc
TNR Tumor 1 =	2.12	:1
Tumor 2 (within Target Region) Volume =	8.8	cc
TNR Tumor 2 =	1.22	:1
Tumor 3 (within Target Region) Volume =	117.91	cc
TNR Tumor 3 =	1.33	:1

Kolligs, et al. *JHEP*. 2022. Schaefer, et al. *CCC*. 2022. Garin, et al. *Lancet*. 2021. Kappadath, et al. *JNM*. 2022. Villalobos, et al. *JVIR*. 2021. Wondergem, et al. *JNM*. 2013. Thomas, et al. *MP*. 2020. Alsultan, et al. *JNM*. 2021.

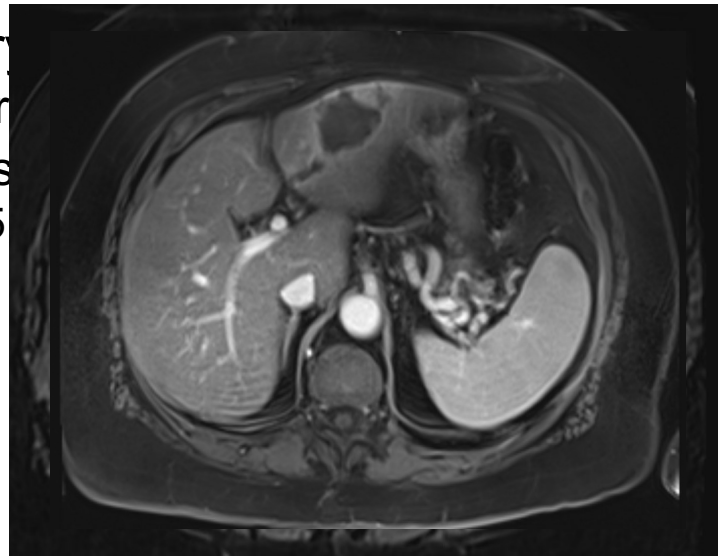
Delivery Workflow

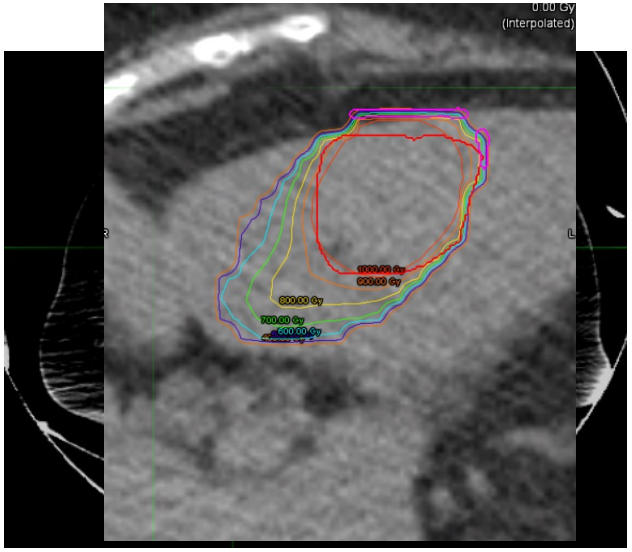
- Replicate mapping
- Any change in plan
  - Repeat CBCT
- Something doesn't smell right
  - Repeat CBCT
- Deliver doses
  - Load catheter with contrast for glass
  - Push dose with 70/30 for resin



Y90 Dosimetry

- Post dosimetry
  - Tumor cover
  - +/- voxel bas
    - V400, D95



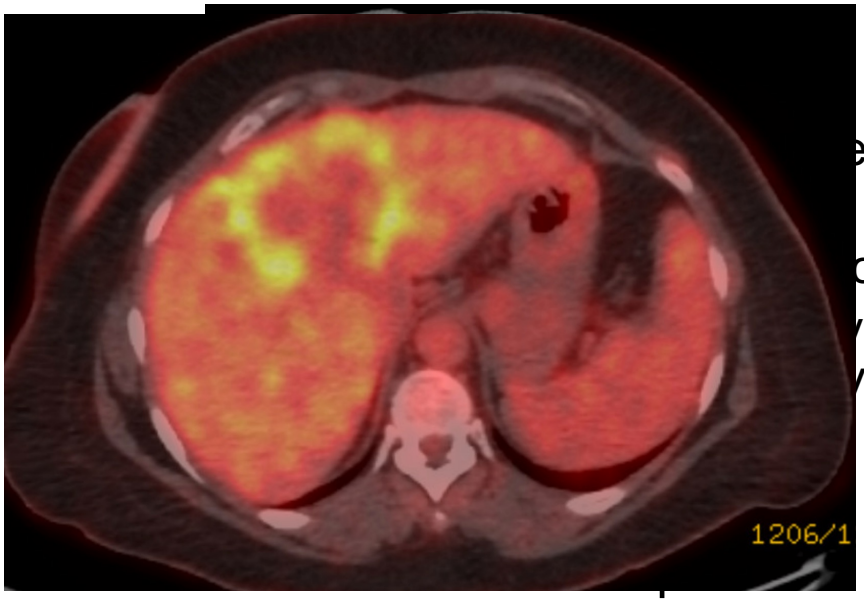


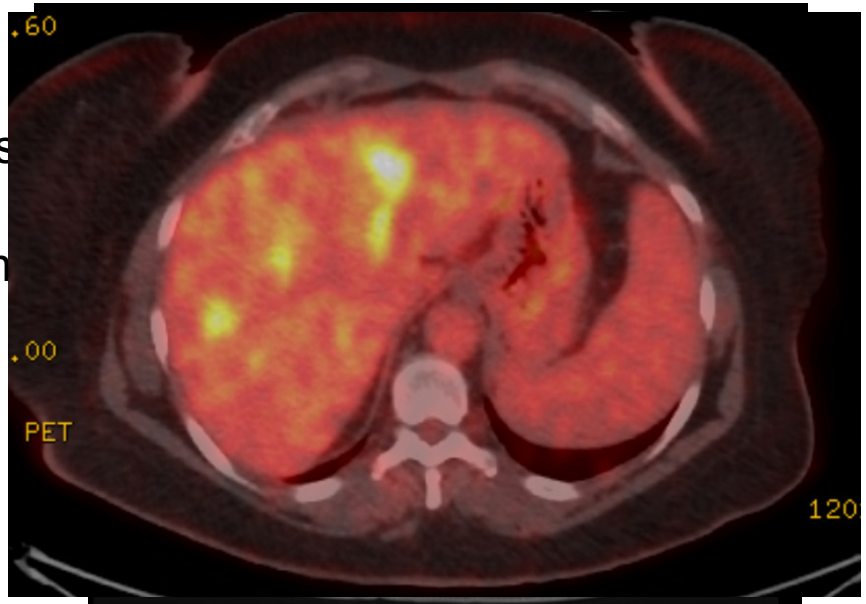
400.00	90.83	99.08
500.00	83.83	98.58
600.00	71.44	97.84
700.00	56.04	96.49
800.00	41.16	90.2

Mean dose perfused 770 Gy
Mean dose tumor 1056 Gy

Sandow, et al. *JVIR*. 2024. Pianka, et al. *EJNMMI*. 2024.

Follow-Up Workflow

- 4-6 wks
- 



  - Must follow your patients
  - Keep the referring physician in the loop

Stocker. *ER*. 2024. Weber, et al. *EJNMMI*. 2022. Prachanronarong, et al. *SIR*. 2021.

Summary

- Time to treatment is important
- Every patient is not the same
- Optimize your workflow and efficiency
  - Traditional treatment paradigm
  - Order/map/treat
  - Same day map/treat
  - Single session
  - Repeat treatment

Thank You

vkpk27@gmail.com
(330) 701-6765

SYMPOSIUM
ON CLINICAL
INTERVENTIONAL
ONCOLOGY

Understanding Resin FLEXDose Delivery Program, Order–Map–Treat

Ripal T. Gandhi, MD, FSIR, FSVM
Miami Cardiac & Vascular Institute
Miami Cancer Institute
Clinical Professor, FIU Herbert Wertheim College of Medicine

Objectives

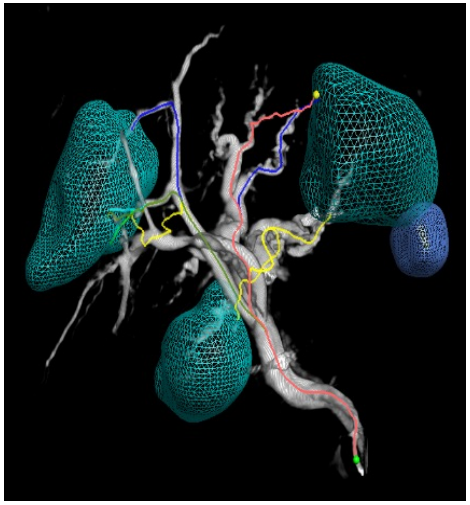
- Order-Map-Treat Strategy
- FlexDose Select– What is It?
- FlexDosing – How I Do It
- Resin Treatment Dose Thresholds
- Sphere Count
- Conclusions

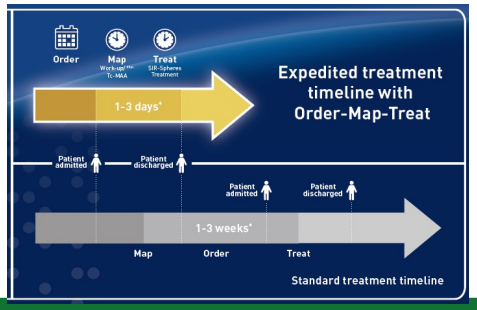
Order–Map–Treat

Strategy

Order-Map-Treat Strategy

Customized Dosing	• Activity can be modified, tailored on day of therapy, and personalized to individual patient-specific needs • Same-day activity draw
Order-Map-Treat Strategy	• Order dose in advance • Have options of higher activity/fewer spheres and less activity/greater spheres with pre-cal doses (FLEXdose Delivery Programme) • Same-day or same-week therapy allow for expedited treatment
Time-Sensitive Clinical Situations	• Allow for flexibility to modify treatment planning





Order-Map-Treat Strategy:

Fast Track from Referral to Treatment

For the Patient	For the Referring MD	For the Treating MD
• Shorter hospital stay (Same-Day Map & Treat) • Reduced delays to treatment • Fewer trips to hospital (Same-Day Map & Treat)	• Improved treatment efficiencies • Reduced interruptions between treatments • Supports continuum of care	• Flexibility for interventional radiologists and nuclear medicine • Improved efficiencies for IR suites • Personalized dose adjustments up to time of treatment

Same Day/Same Week Y90

Resin Microspheres Can Easily Be Fractionated on Day of Procedure

- Choose appropriate FlexDose Select that you desire and order prior to mapping
- Dose can be fractionated as needed following mapping procedure and can be modified on the day of treatment as necessary

Glass Microspheres Come In Pre-Calibrated, Sealed Vials

- Dose vials must be ordered in advance
- Must do planning for anticipated treatment volume to order proper dose vials
- Cannot be fractionated

Can Perform Dosimetry After the Mapping

- Does not require much pre-procedural planning other than ordering dose
- If doing lobar Y90 or radiation segmentectomy, can calculate tumor volume and estimate liver volumes before the mapping

FlexDose Select Delivery Program

FLEXDose Delivery Program

Flexibility to Deliver the Same Activity with More or Fewer Spheres

Changes:

27.3M microspheres/vial

Higher specific activity option (5DPC)

6DPC

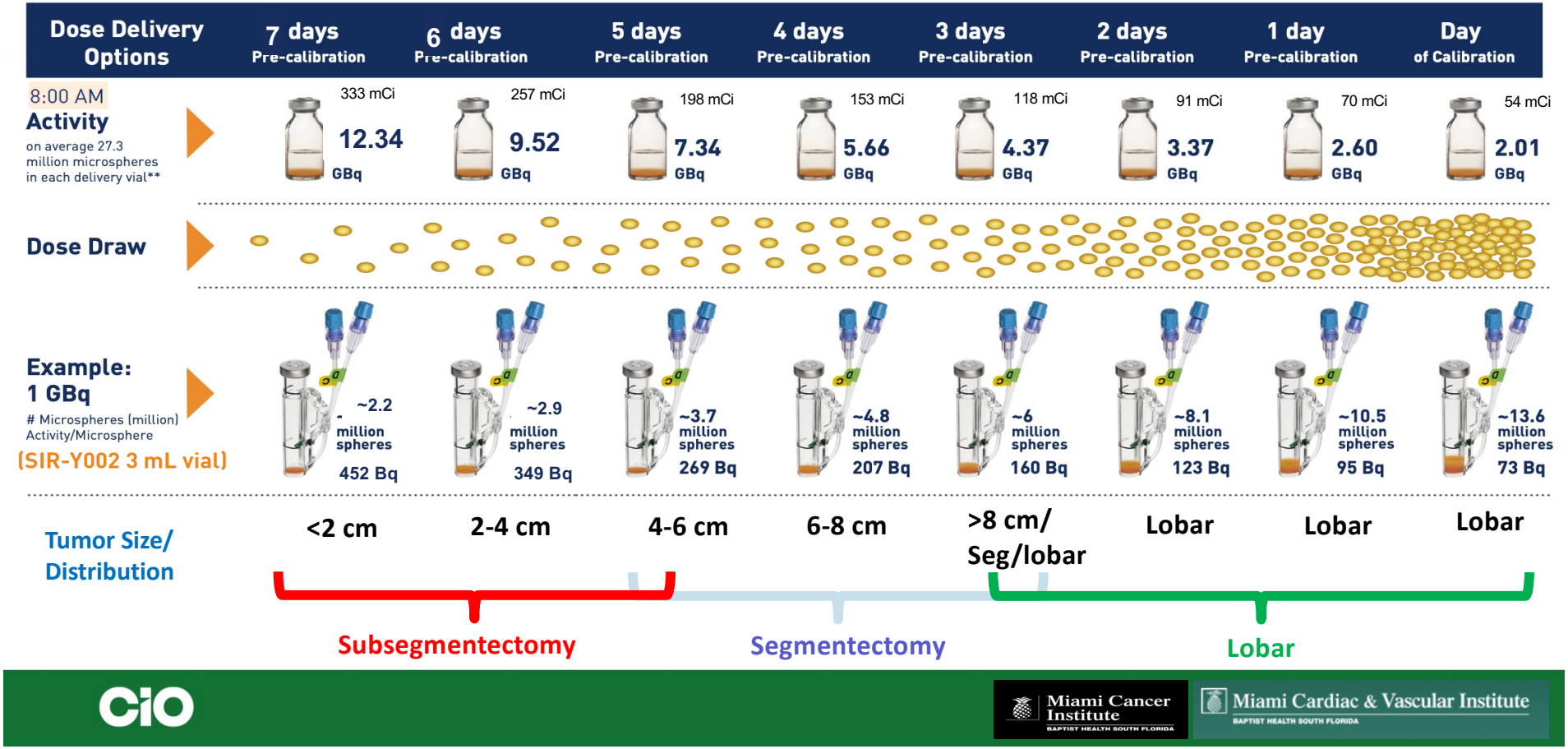
7DPC

Will not change:

- Availability of other days of calibration
- Specific activity (per microsphere) of other vial options
- Approved indication

FLEXDose Delivery Program

Flexibility to Deliver the Same Activity with More or Fewer Spheres



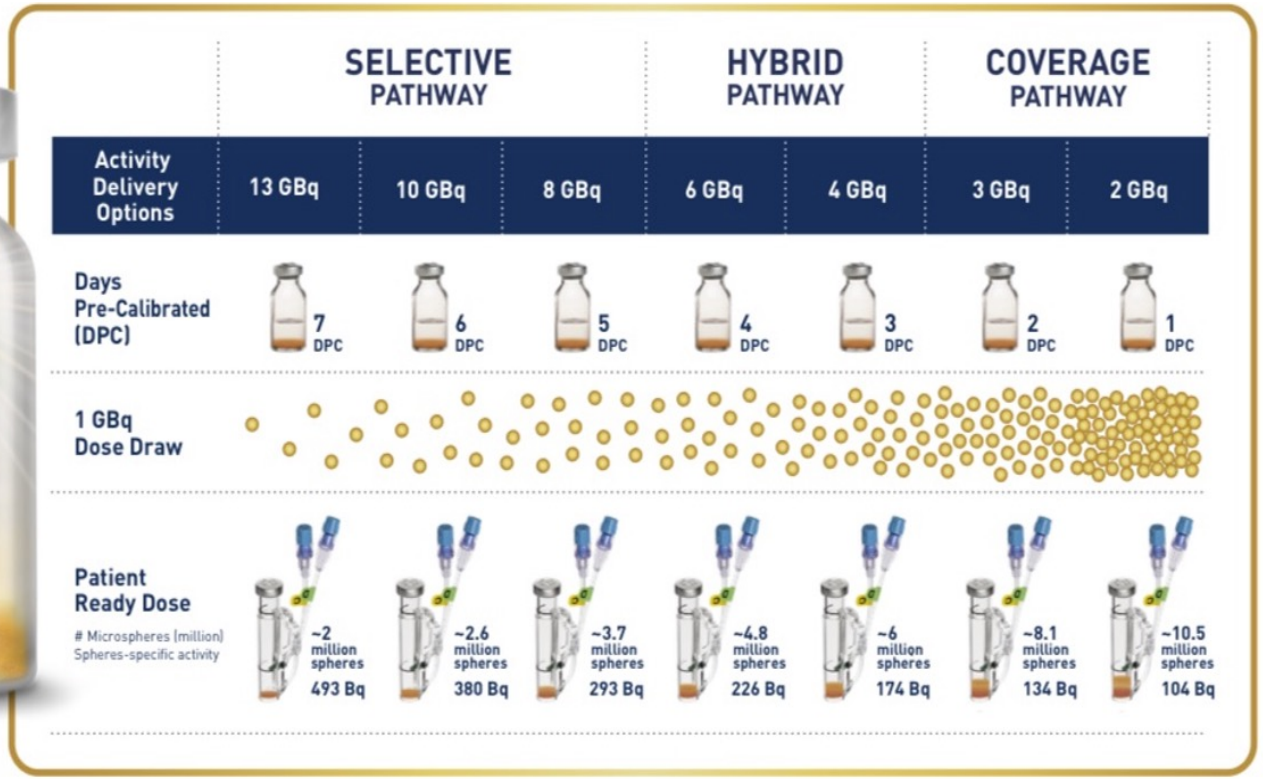
CIO

Miami Cancer Institute
BAPTIST HEALTH SOUTH FLORIDA

Miami Cardiac & Vascular Institute
BAPTIST HEALTH SOUTH FLORIDA

FLEXDose Delivery Program

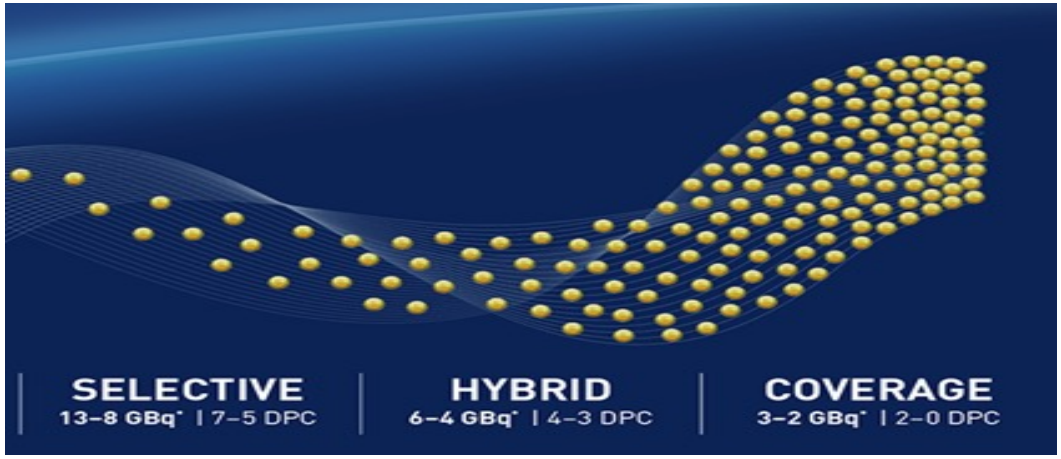
Flexibility to Deliver the Same Activity with More or Fewer Spheres



Resin Y90	Glass Y90
7-day precal	Week 2 Monday theraspheres
6-day precal	Week 2 Tuesday theraspheres

FLEXDose Delivery Program

Flexibility to Deliver the Same Activity with More or Fewer Spheres



Tumor Size (Rad Seg)	Precalibration FLEXDose
<4 cm	5-7 day precalibration
4-8 cm	3-4 day precalibration

For lobar of multifocal bilobar disease:

- 2-day precalibration
- 1-day precalibration (if very large tumor or large liver)

For RAD SEG:

- 3-day to 7-day precalibration
- Varies depending on tumor size (see table at left)

Benefits of FLEXDose SELECT Pathways

Treating Physician	For Patients
Flexibility and convenience	Customized treatment
Control – control of dosing and administration	Precise activity delivered
Ease of use	Optimal tumor coverage
Adaptability	

Dose Summary Review

Partition Model (aka 2 Compartment Model)

What is Tumoricidal Dose?

- Resin > 100-120 Gray (ideally > 250 gy if unilobar)

What is threshold normal liver dose?

- 40 Gray (70 Gy if unilobar)
- Less than 30 Gy if compromised liver function, heavily pre-treated

What is threshold lung dose?

- 30 Gy single administration
- 50 Gy lifetime

European Journal of Nuclear Medicine and Molecular Imaging
https://doi.org/10.1007/s00259-020-05163-5

GUIDELINES

International recommendations for personalised selective internal radiation therapy of primary and metastatic liver diseases with yttrium-90 resin microspheres

Hugo Levillain[1] · Oreste Bagni[2] · Christophe M. Deroose[3] · Arnaud Dieudonné[4] · Silvano Gnesin[5] · Oliver S. Grosser[6] · S. Cheenu Kappadath[7] · Andrew Kennedy[8] · Nima Kokabi[9] · David M. Liu[10] · David C. Madoff[11] · Armeen Mahvash[12] · Antonio Martinez de la Cuesta[13] · David C. E. Ng[14] · Philipp M. Paprottka[15] · Cinzia Pettinato[16] · Macarena Rodriguez-Fraile[13] · Riad Salem[17] · Bruno Sangro[13] · Lidia Strigari[18] · Daniel Y. Sze[19] · Berlinda J. de Wit van der veen[20] · Patrick Flamen[1]

Received: 11 September 2020 / Accepted: 8 December 2020

Chiesa A, et al. *QU Mol Im* 2012. Lau, et al. *Int J Radiat Oncol Biol Phys.* 2012;82:401. Levillain H, et al. *Eur J Nucl Med Mol Imaging* (online 1/21)

Dose Summary

Seminars in Interventional Radiology Vol. 41 No. 1/2024 © 2024. How I Do It

Yttrium-90 Radioembolization Dosimetry: Dose Considerations, Optimization, and Tips

Alexander Villalobos, MD[1] Johannes L. du Pisanie, MD[1] Ripal T. Gandhi, MD, FSIR, FSVM[1]
Nima Kokabi, MD, FRCPC[1]

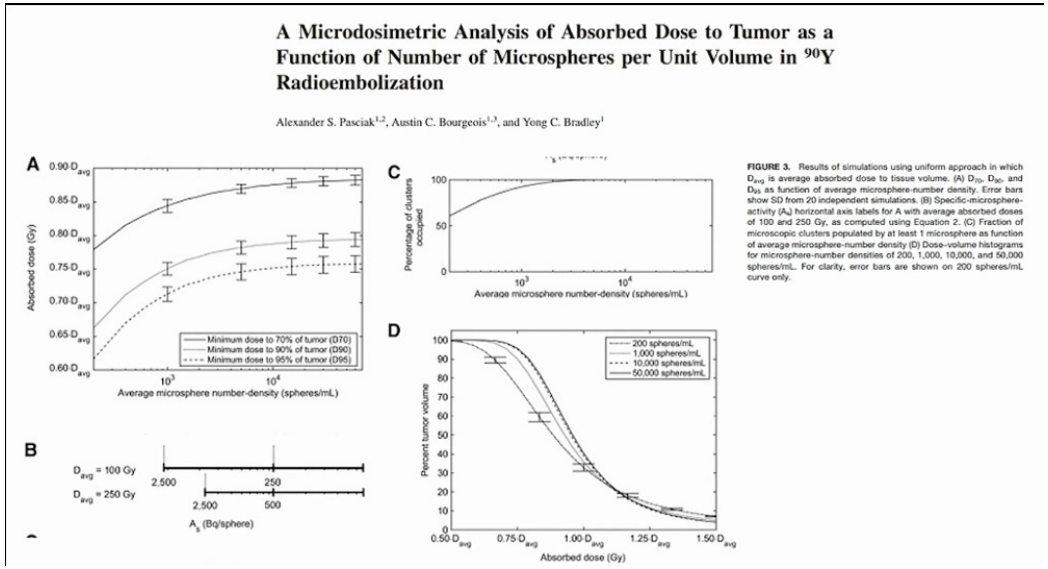
Table 4 Yttrium-90 radioembolization quick reference table—table references common clinical scenarios where yttrium-90 radioembolization can be used

Clinical scenario	Treatment intent	Ideal liver function (Child-Pugh)	Primary recommended dosimetry model	Dose goal[a]	
				Glass	Resin
Radiation segmentectomy (Y90-RS)	Curative	A–B7 >B7[b]	Single compartment (MIRD model)	>400 Gy to angiosome	>250 Gy[c] to angiosome
Radiation lobectomy (Y90-RL)	Potentially curative; contralateral hypertrophy; "test of time"	A	Multicompartment (partition model)	Non-tumor: >88 Gy Tumor: >205 Gy	Non-tumor dose: >70 Gy Tumor: >250 Gy[c] ideally
Multifocal unilobar	Palliative	A–B7	Multicompartment (partition model)	Non-tumor w/ CP A: 100–120 Gy[c] Non-tumor w/ CP B: <70 Gy[c] Tumor: >205 Gy (ideally >250 Gy)	Non-tumor: 40–70 Gy[c] Tumor: >250 Gy ideally
Multifocal bilobar	Palliative	A	Multicompartment (partition model)	Non-Tumor: 40-70 Gy Tumor: >205 Gy (Ideally >250 Gy)	Non-tumor: 30–40 Gy Tumor: >100 Gy[c]
HCC with microvascular invasion and/or portal vein thrombus	Palliative	A[b] Ideally, must have good Tc-99m MAA uptake in MVI[c]	Multicompartment (partition model)	If unilobar MVI/PVT: R90-RL vs. Y90-unilobar approach[c] If bilobar MVI/PVT: Y90-bilobar approach[c]	If unilobar MVI/PVT: R90-RL vs. Y90-unilobar approach[c] If bilobar MVI/PVT: Y90-bilobar approach[c]

- **>350-400 Gy to angiosome → >435 Gy to tumor**
- **180 Gy MIRD to lobe (3-day flex dose)**
- **>400 Gy to Segment and 180 Gy lobar (3-day)**

What about Sphere Count?

How Many Spheres Do You Need?



A Microdosimetric Analysis of Absorbed Dose to Tumor as a Function of Number of Microspheres per Unit Volume in ^{90}Y Radioembolization

Alexander S. Pasciak[1,2], Austin C. Bourgeois[1,3], and Yong C. Bradley[1]

FIGURE 3. Results of simulations using uniform approach in which D_{avg} is average absorbed dose to tissue volume. (A) D_{70}, D_{90}, and D_{95} as function of average microsphere-number density. Error bars show SD from 20 independent simulations. (B) Specific-microsphere-activity (A_s) horizontal axis labels for A with average absorbed doses of 100 and 250 Gy, as computed using Equation 2. (C) Fraction of microscopic clusters populated by at least 1 microsphere as function of average microsphere-number density (D) Dose-volume histograms for microsphere-number densities of 200, 1,000, 10,000, and 50,000 spheres/mL. For clarity, error bars are shown on 200 spheres/mL curve only.

- Compared to 50k spheres/ml, decrease in D70 were statistically significant below 20k spheres/ml
- Differences in microsphere number density may have an effect on the microscopic tumor absorbed dose inhomogeneity, which may explain differences in treatment planning between glass and resin y90 devices

Pasciak AS, et al. *J Nucl Med.* 2016.

How Many Spheres Do You Need for Curative Intent

Journal of Vascular and Interventional Radiology
Available online 21 March 2023
In Press, Journal Pre-proof What's this?

Clinical Study

Yttrium-90 Radiation Segmentectomy of Hepatocellular Carcinoma: A Comparative Study of Effectiveness, Safety, and Dosimetry of Glass vs. Resin-based Microspheres

Alexander Villalobos MD [1], Linzi Arndt BS, MBA [1], Bernard Cheng MD [1], Howard Dabbous MD [1], Mohammed Loya MD [1], Bill Majdalany MD [1], Zachary Bercu MD [1], Nima Kokabi MD FRCPC [1]

- 3-day pre-cal Resin
- Mean: 40,000 microspheres/cc tumor → **CR**

European Journal of Nuclear Medicine and Molecular Imaging
https://doi.org/10.1007/s00259-025-07471-0

ORIGINAL ARTICLE

Histopathologic outcomes of hepatocellular carcinoma treated with transarterial radioembolization with yttrium-90 resin microspheres

Ammar Sarwar[1] · Imad Nasser[2] · Jeffrey L. Weinstein[1] · Mahmoud Odeh[1] · Hafsa Babar[3] · Diana Dinh[1] · Michael Curry[4] · Andrea Bullock[5] · Devin Eckhoff[6] · Martin Dib[6] · John A. Parker[7] · Muneeb Ahmed[1]

- 3-day pre-cal Resin
- Median: 78,000 microspheres/cc tumor → **CPN**

How Many Spheres Do You Need?

Methods

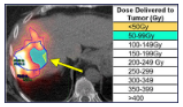
- Rad seg with Resin with post Y90 PET CT
- Median tumor size 3.4 cm HCC

Results

- Tumors 86% CR, 100% ORR at 6 months
- No differences between CR and incomplete responders in tumor size, volume, dose, or specific activity
- Incomplete responders had a lower D50 than CR (162 vs 273 gray), lower particle density (**36,310 vs 66,980 particles/cm^3**), and higher underdosed tumor volumes
- **Note:** Montazeri SA, et al. showed specific activity >327 Bq/sphere was predictor of CR; however, in this study, 156 vs 158 Bq/sphere for CR vs incomplete response

Note: D50 is minimum absorbed dose to 50% of volume

Vo NH, et al. *JVIR*. 2025.



Prediction of Recurrence of Hepatocellular Carcinoma Following Radiation Segmentectomy with Resin Microspheres Based on Underdosed Tumor Volume on Yttrium-90 Positron Emission Tomography/CT Dosimetry

Nhi H. Vo, MD, Muhammad Saad Malik, MD, Muhammad Mohid Tahir, MD, J. Anthony Parker, MD, PhD, Leo L. Tsai, MD, PhD, Diana Dinh, MD, Marnix Lam, MD, PhD, Jeffrey Weinstein, MD, Muneeb Ahmed, MD, and Ammar Sarwar, MD

ABSTRACT

Purpose: To evaluate the use of immediate post–yttrium-90 (^{90}Y)-radiation segmentectomy (RS) positron emission tomography (PET)/computed tomography (CT) and dosimetry software in predicting incomplete response in early-stage hepatocellular carcinoma (HCC).

Materials and Methods: Patients with early-stage HCC undergoing resin ^{90}Y-RS (July 2014 to December 2022) prescribed using the single-compartment Medical Internal Radiation Dose (MIRD) model with post–^{90}Y transarterial radioembolization (TARE) PET/CT were reviewed. Forty patients (42 HCCs; 69 years [interquartile range {IQR}, 63–77]; male, 75%), with a median tumor size of 3.4 cm (IQR, 2.2–4.6) met criteria. Dose-volume histograms were generated using dosimetry software (MIM SurePlan LiverY90, v7.2.3). Modified Response Evaluation Criteria in Solid Tumours (mRECIST) treatment responses were correlated with quantitative volumetric analyses of tumor absorbed dose (TAD) and underdosed tumor volume, defined as volume of tumor receiving less than 100 Gy ($V_{0–100}$). Additional subgroup dosimetry analysis was performed between tumors with complete response (CR) and incomplete response.

Results: Tumors treated showed 86% CR and 100% objective response rate at 6-month follow-up. Subgroup analysis between CRs and incomplete responders showed no difference in tumor size, volume, prescribed tissue dose, or prescribed, delivered, or specific activity. Incomplete responders had a lower D_{50} than CRs (162 vs 273 Gy, P = .040), lower particle density (36,310 vs 66,980 particles/cm^3, P = .040), and higher absolute (10 vs 0.7 mL; P = .011) and proportion (33% vs 5%; P = .001) of underdosed tumor volumes ($V_{0–100}$). An underdosed tumor volume ($V_{0–100}$) of ≥28% had an increased likelihood of incomplete response (odds ratio, 75; P = .001).

Conclusions: ^{90}Y-TARE PET/CT can identify tumors incompletely treated with an ablative ^{90}Y-RS dose and guide decision for closer follow-up or early retreatment.

Conclusions

FLEXDose

- Customized dosing depending on clinical situation
- For larger tumors/livers → day of calibration, 1-day or 2-day precalibration → I use 2-day precalibration
- For rad seg → 3-day to 7-day precalibration FLEXDose

Order Map Treat

- Allows for faster treatment
- Flexibility and ability to personalize dose to day of Y90

Tumoricidal Dose

- Rad Seg → MIRD → > 350-400 Gy to segment
- Lobar Therapies → Partition → at least 100 Gy to tumor and limit normal liver dose to <30-40 Gy
- Radiation Lobectomy: >70 Gy to background liver vs 180 Gy MIRD

Thank You

Understanding Ordering Surplus Glass Doses for Expedited Treatment

Osman Ahmed, MD
Professor of Radiology
University of Utah

CIO

Y-90 Glass Microspheres Expedited Delivery

Flexibility of **expedited delivery** services meets the needs of evolving physician schedules and emergent clinical situations.

Order for treatments within 48 hrs

Personalized dose delivered for patient treatment

Surplus ordering

Normal workflow – Just in time manufacturing

- Map to Treat 7-10 days
- Dose made for specific patient
- Dose arrives 24-48 hrs ahead of procedure

Surplus ordering is an “abnormal” workflow but can be done

Typically utilized for out-of-town patients/last minute deliveries

- Map to Treat in 48 hrs

Surplus Ordering

Orders placed by 12pm EST can ship same day for overnight delivery by 10:30am (local time)

Surplus stock is standard doses (3,5,7,10,15, 20 GBq)

- Surplus stock kept at 15% based on historical usage

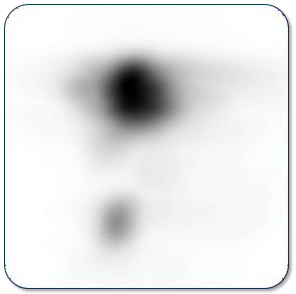
Requested dose not guaranteed

Work directly with rep to ensure smooth process

Treatment Pathway

Planning Phase

- **CTA/MRI**
- **Angiography/Mapping**
  - Assess vasculature and delivery route
  - Evaluate extrahepatic flow to GI tract (Consider embolization where needed)
- **Tc-99m MAA Scan**
  - Determine lung shunt and detect for possible extra-hepatic deposition of Y90
- **Dose Calculation/Ordering**
- **Treatment**



Dose Options

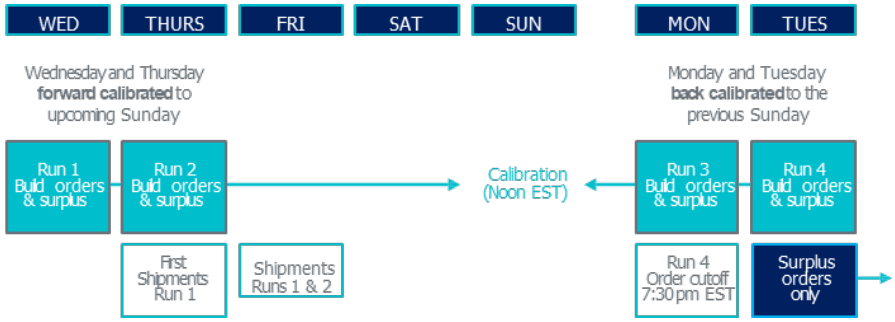
Standard Doses (GBq): 3, 5, 7, 10, 15 & 20

- Between 3 and 20 GBq in 0.5-GBq increments are available (approximately 400K spheres per GBq activity at calibration)

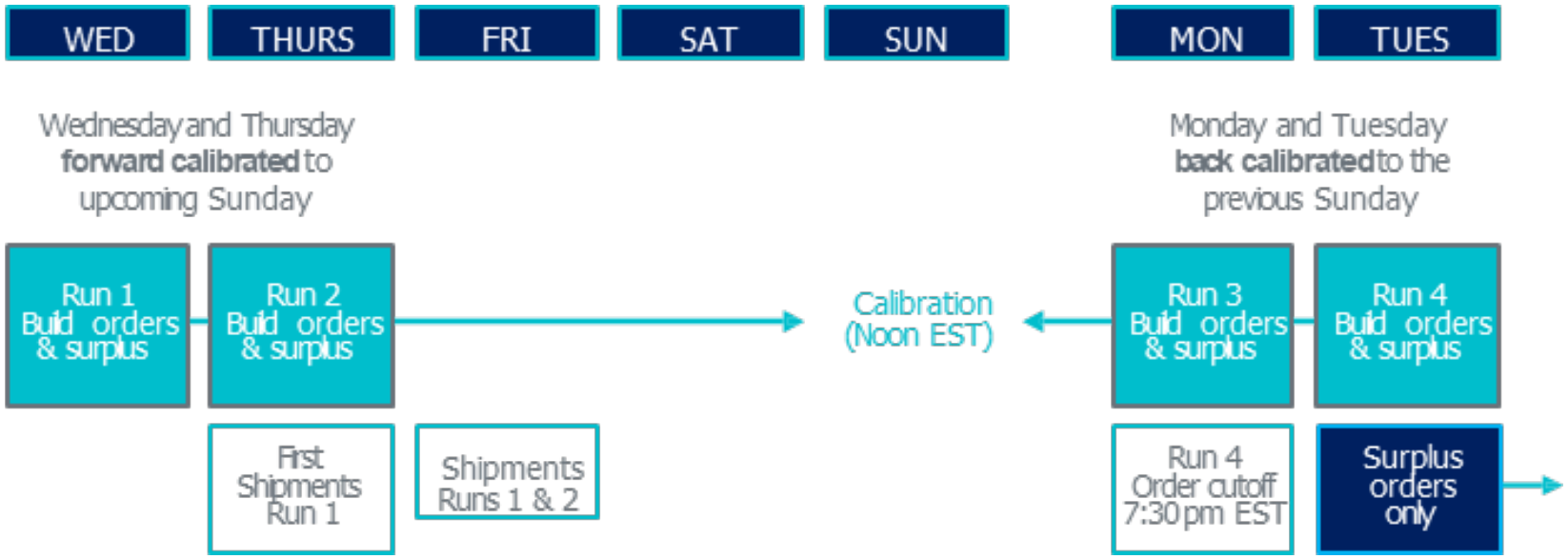
Manufacturing runs are referenced to a single calibration date (Sundays at Noon EST)

Preferably 7 days should be allowed between placing the order and treatment date (allows for shipment)

Glass dose vials arrive 1-2 days in advance of treatment date



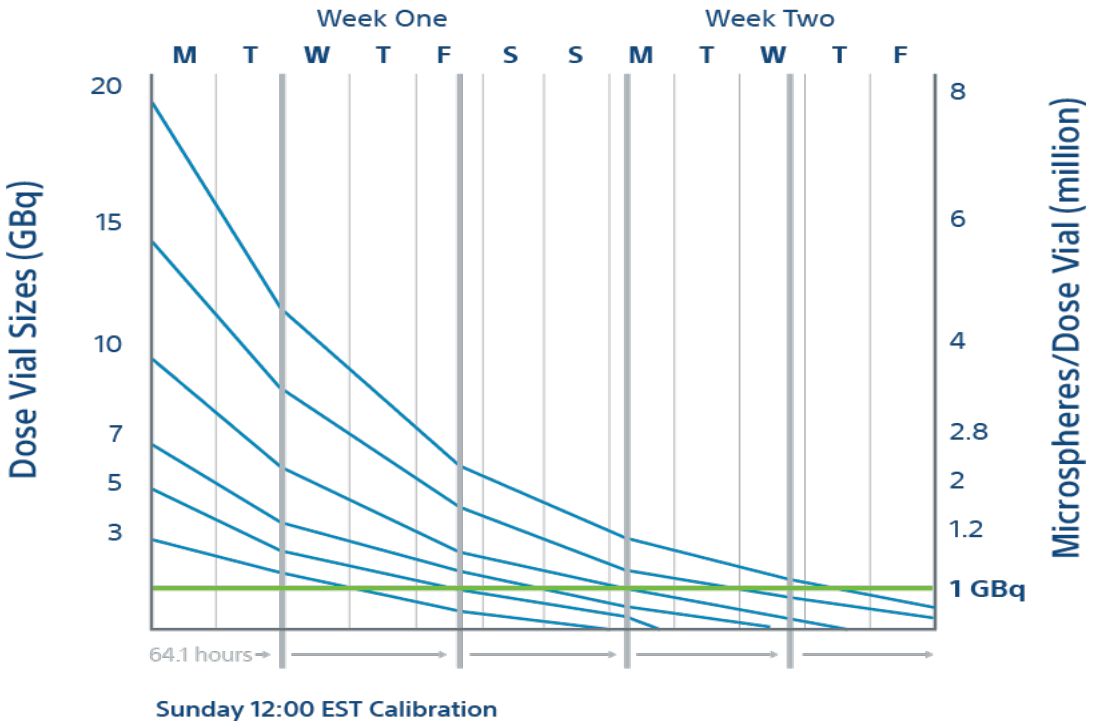
Dose Options



Dosing Flexibility for Personalized Treatment

Activity (± 10% GBq)	Mass of Microspheres (mg)	No. of Microspheres (millions)
3	27	1.2
5	45	2.0
7	63	2.8
10	90	4.0
15	135	6.0
20	180	8.0

Dosing Flexibility for Personalized Treatment



Conclusion

Typically use surplus orders for emergent situations or out-of-town patients (ie, to accommodate them)

- Will arrive 1-2 days prior to administration

Work directly with rep for surplus dosing

Can only order “standard” doses

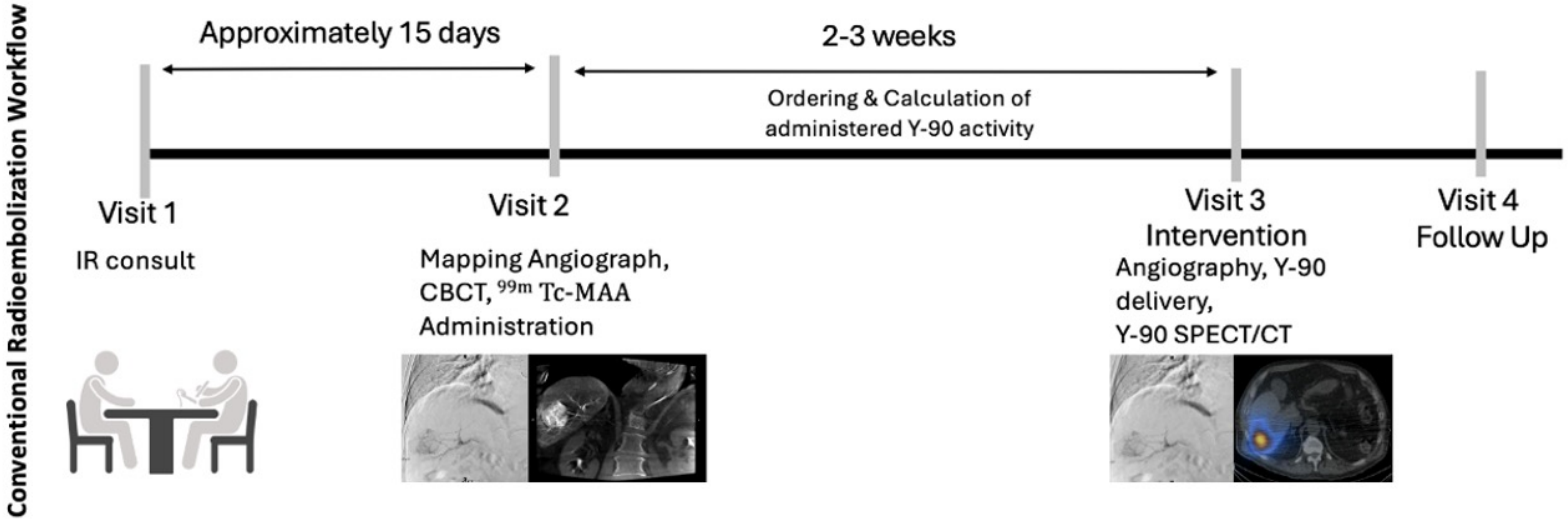
Utility of Single Session Y90 Treatment

Nima Kokabi, MD, FRCPC

Associate Professor of Radiology, Hepatology, Medical Oncology
Vice Chair of Clinical Research
Director of Interventional Oncology
UNC School of Medicine

CIO

Conventional Workflow



SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

SCHOOL OF MEDICINE
Radiology

UNC SCHOOL OF MEDICINE

CIO SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

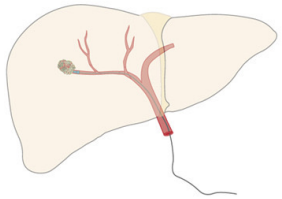
- Rising cost of healthcare
- Limited resources
- Wait times for cancer care

SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Do we need to calculate LSF for small HCC?

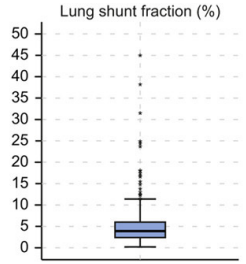
UNC SCHOOL OF MEDICINE



Solitary HCC ≤5 cm **OR** ≤3 Tumors ≤3 cm

⊕ No prior TIPS placement

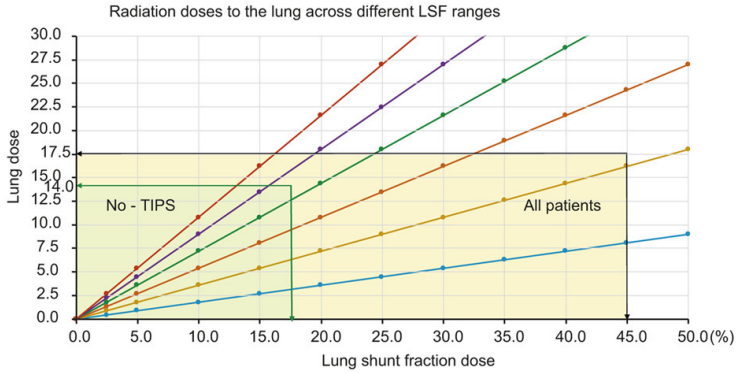
⊕ Planned selective TARE



= Low lung shunt fraction

↓

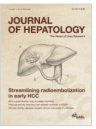
- Safe selective TARE without MAA study
- No radiation risk to the lungs



RESEARCH ARTICLE · Volume 72, Issue 6, P1351-1158, June 2020 Download Full Issue

Streamlining radioembolization in UNOS T1/T2 hepatocellular carcinoma by eliminating lung shunt estimation

Ahmed Gabr [1] · Srirajkumar Ranganathan [1] · Samdeep K. Mouli [1] · Ahsun Riaz [1] · Vanessa L. Gates [1] · Laura Kulik [2] · Daniel Ganger [2] · Haripriya Maddur [2] · Christopher Moore [2] · Elias Hohlastos [1] · Nitin Katariya [3] · Juan Carlos Caicedo [3] · Aparna Kalyan [4] · Robert J. Lewandowski [1,3] · Riad Salem [1,3,4] Show less



Retrospective
N=448 OPTN Stage T1/T2 HCC
Glass-based microsphere
Conventional 2-session mapping and treatment approach

Median LSF: 3.9% (IQR 2.4–6%)
No LSF>16%
No Lung dose >14 Gy

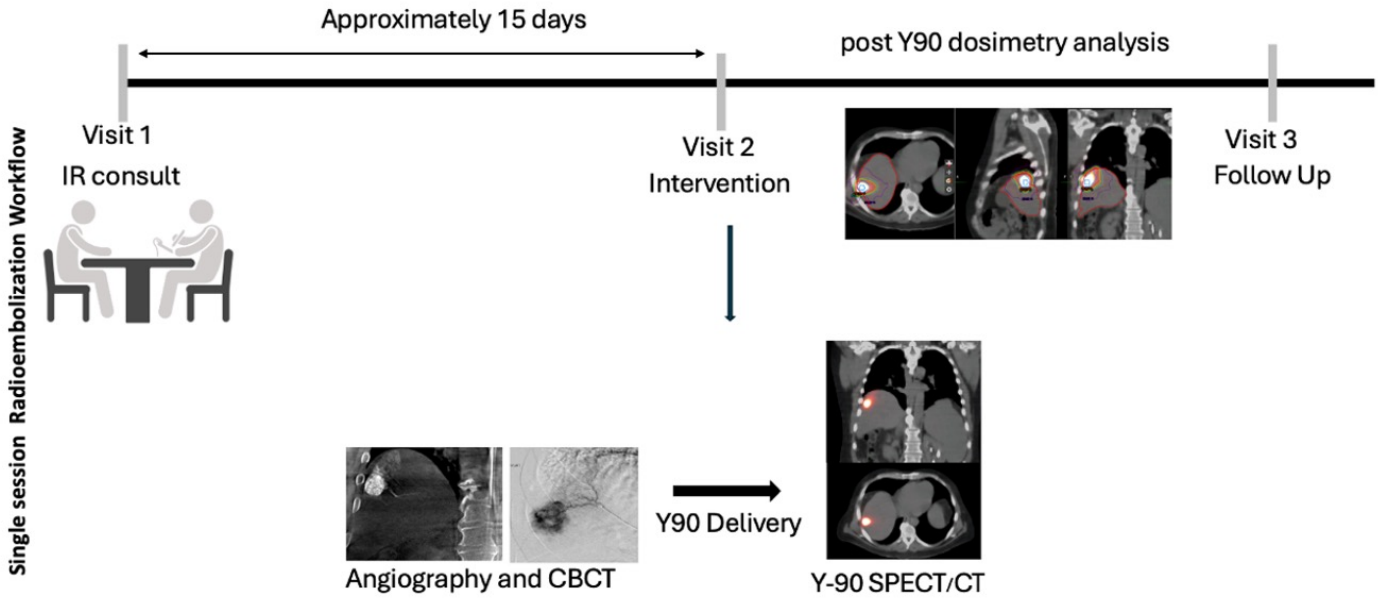
UNC SCHOOL OF MEDICINE Radiology

UNC SCHOOL OF MEDICINE

CIO SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Single-Session Workflow



SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Patient Selection

UNC SCHOOL OF MEDICINE

Patient Selection Criteria

- OPTN Stage I/II HCC (≤5 cm, ≤3 nodules)
- No macrovascular invasion, no TIPS
- Child–Pugh A–B7, bilirubin <2, ECOG <2
- No arterial enhancement of venous structures on MRI/CT or intraprocedural CT

CIO SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Evidence

- 4 studies
  - 2 Glass-based microspheres
  - 1 Resin-based microsphere
  - 1 both Glass- and Resin-based microspheres

UNC SCHOOL OF MEDICINE

UNC SCHOOL OF MEDICINE
Radiology

Glass-Based Microsphere

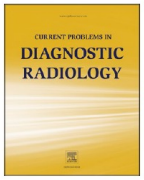
UNC SCHOOL OF MEDICINE

Current Problems in Diagnostic Radiology 54 (2025) 308–312

Contents lists available at ScienceDirect

Current Problems in Diagnostic Radiology

journal homepage: www.cpdrjournal.com



Learning from Experience

Expediting care for hepatocellular carcinoma ≤ 3 cm by streamlining radiation segmentectomy: A quality improvement project

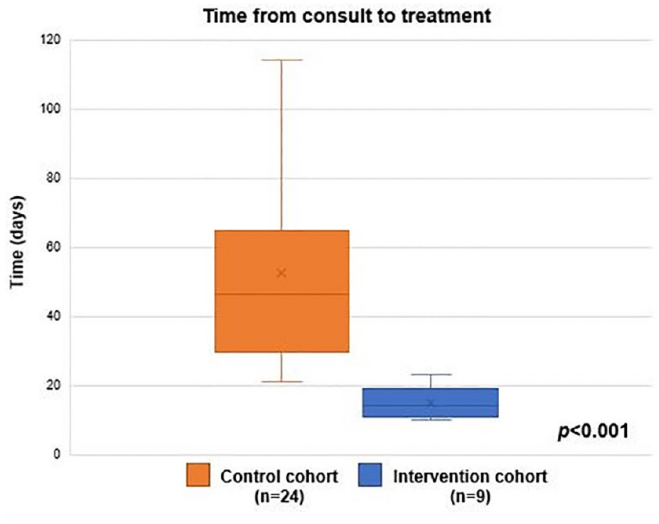
Cynthia De la Garza-Ramos [a], Steven Bussone [b], LaRissa L. Adams [c], Maeghan D. Barber [b], Gregory T. Frey [a], Andrew R. Lewis [a], Ricardo Paz-Fumagalli [a], Beau B. Toskich [a,*]

[a] Division of Interventional Radiology, Mayo Clinic Florida, Jacksonville, FL, USA
[b] Department of Radiology, Mayo Clinic Florida, Jacksonville, FL, USA
[c] Systems Quality Office, Mayo Clinic Florida, Jacksonville, FL, USA

CIO SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

- Treatment N=9 patients (prospective)
- Control N=24 patients (retrospective)
- **Time to treatment**
  - 14 days (IQR 12–15) vs 47 days (IQR 31–64)
- **LSF**
  - 2.7 Gy (IQR 2.1, 3.6) vs 2.2Gy (IQR 1.0, 4.6)
- **Fluoroscopy time**
  - 8 min (IQR 14, 19) vs 28 min (IQR 24, 43)



SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Glass-Based Microsphere

Cardiovasc Intervent Radiol (2024) 47:1239–1245
https://doi.org/10.1007/s00270-024-03799-6

CIRSE

Check for updates

CLINICAL INVESTIGATION INTERVENTIONAL ONCOLOGY

Single-Session Ablative Transarterial Radioembolization for Patients with Hepatocellular Carcinoma to Streamline Care: An Initial Experience

Zachary T. Berman[1] · Kurt Pianka[1] · Yousuf Qaseem[1] · Jonas Redmond[1] · Jeet Minocha[1]

SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Results

- Retrospective N=15
  - 16 consecutive procedures
- Technical success: **88%**
  - **2 patients couldn't undergo single session b/c of intraprocedural findings**
- 25% required ≥2 vials for complete coverage
- **Median procedure time: 86 min**
  - ~$7,000 saved per patient
- **No radiation pneumonitis**
- Complete response**: 94%**

SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Resin-Based Microsphere

UNC SCHOOL OF MEDICINE

cancers

MDPI

Article

Initial Experience with Single-Session Resin-Based Transarterial Radioembolization Mapping and Treatment of Small Hepatocellular Carcinomas

Michael Mohnasky [1,*], Sandra Gad [1,2], Marco Fanous [1], Johannes L. Du Pisanie [3], Marija Ivanovic [3], David M. Mauro [3], Hyeon Yu [3], Alex Villalobos [3], Andrew M. Moon [4,5], Hanna K. Sanoff [6], Jingquan Jia [6] and Nima Kokabi [3]

CIO SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Results

- **Retrospective**
- **Treatment N=10 pts (Resin-based microspheres)**
- Control N=60 pts (Glass-based microspheres)

SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

SCHOOL OF MEDICINE Radiology

Results

- No radiation pneumonitis
- **Complete response 90%**
- **No Grade 3+ AE**
- **Median to time Rx from IR clinic: 26.5 days vs 61 days (*p*<0.001)**
- **Procedure time:** 142 vs 151 min (NS)
- **Fluoroscopy time**: 25 vs 23 min (NS)

SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Cost Savings

UNC SCHOOL OF MEDICINE

Table 4. Cost comparison of mapping and Y90 treatment procedures.

	Hospital Outpatient (OPPS) (USD)	Physician Services (MFFS) (USD)	Total Cost (USD)
Mapping Total Cost	25,400.86	1231.25	26,632.11
75,726: Angiography, visceral, RS&I	5405.70	90.57	
37,242: Arterial emb or occ, RS&I; arterial other than hem or tumor (includes catheter placement, 3D post-scan, ^{99m}TC-MAA dose, radiopharmaceutical quantification measurement)	17,956.72	1042.99	
74,170: CT, abdomen; w and w/o contrast	178.02	63.40	
78,801: Planar imaging of multiple areas	401.83	32.35	
78,832: SPECT/CT imaging of multiple areas	1458.59	92.51	
Y90 Treatment Total Cost	36,685.53	1283.67	37,969.20
75,726: Angiography, visceral, RS&I	5405.70	90.57	
C2616: Brachytherapy source (yttrium-90 non-stranded–Medicare)	17,412.53	-	
37,243: Vascular emb or occ, inclusive of all RS&I, intraprocedural road mapping, and imaging guidance necessary to complete intervention; for tumors	11,340.57	858.64	
77,370: Special Medical Radiation Physics Consultation	132.77	-	
77,470: Special Treatment Procedure	578.47	104.48	
77,300: Basic Dosimetry Calculation	132.77	32.02	
79,445: Radiopharmaceutical therapy, intra-arterial particulate admin (1 doctor model (IR/AU))	224.13	105.45	
78,832: SPECT/CT imaging of multiple areas	1458.59	92.51	

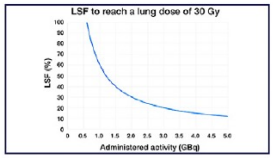
↓41% Cost

UNC SCHOOL OF MEDICINE Radiology

Resin and Glass-Based Microsphere

UNC SCHOOL OF MEDICINE

CLINICAL STUDY



Streamlining Radioembolization without Lung Shunt Estimation versus Regular Radioembolization in Patients with Hepatocellular Carcinoma within the Milan Criteria

Hyo-Cheol Kim, MD, Minseok Suh, MD, Jin Chul Paeng, MD, Jong Hyuk Lee, MD, Myungsu Lee, MD, Jin Wook Chung, MD, and Jin Woo Choi, MD

CIO SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Results

- Retrospective, single-center, cohort study
- N = 100 consecutive patients
  - **Conventional** N=38
  - **Single session** N=62
- Microspheres: glass (n=84), resin (n=16)
- **Serious AEs ≥ Grade 3**
  - **Conventional**: 7.9%
  - **Single session**: 3.2%

SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Results

- **Glass Microspheres**
- CR rates:
  - Conventional: 96.9%
  - **Single session: 90.4%**
- No significant difference

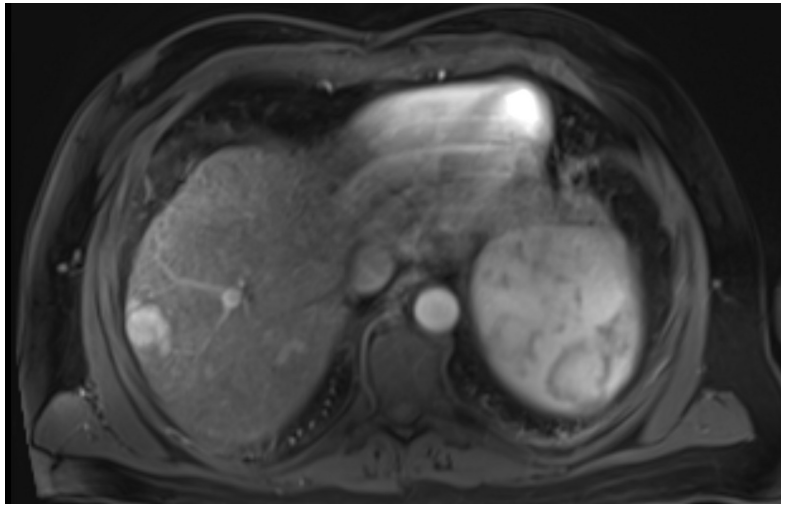
- **Resin Microspheres**
- Small numbers (n=16)
- CR rates:
  - Conventional: 66.7%
  - **Single session: 90%**
- No significant differences

SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Case Example

- 68-yr-old Male with history of HCV
- Bili 0.5, ECOG 1, Child-Pugh A5
- LR 5
- 2.4 cm HCC
- 28 days from consult to treatment



SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Dosimetry

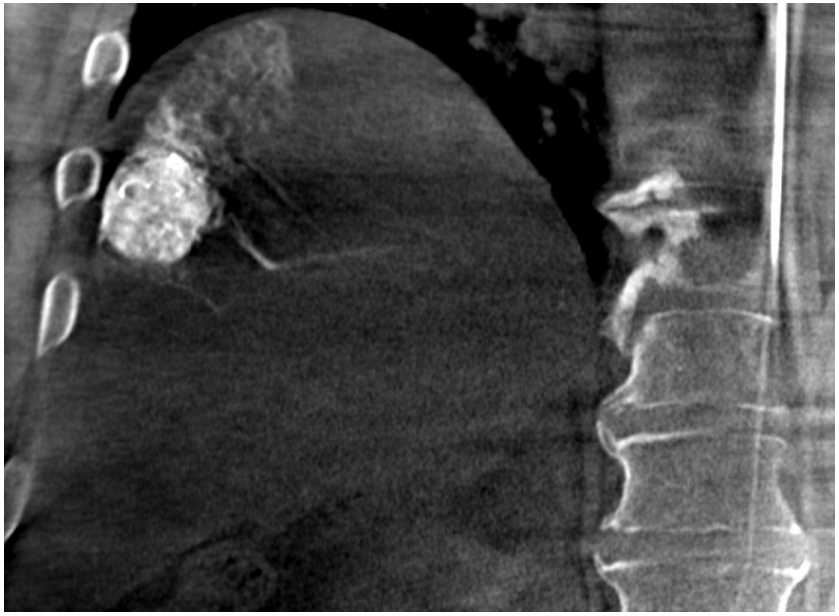
- Angiosome volumetry by CBCT
- 5-day pre-cal Resin
- **Target >300 Gy**
- 2 options:
  - Call nuc med to draw the dose after volumetry → wait ~30 minutes for the box(es) to arrive
  - Have 3 boxes pre-drawn and ready in the room

27 mci (150 cc)

36 mci (200 cc)

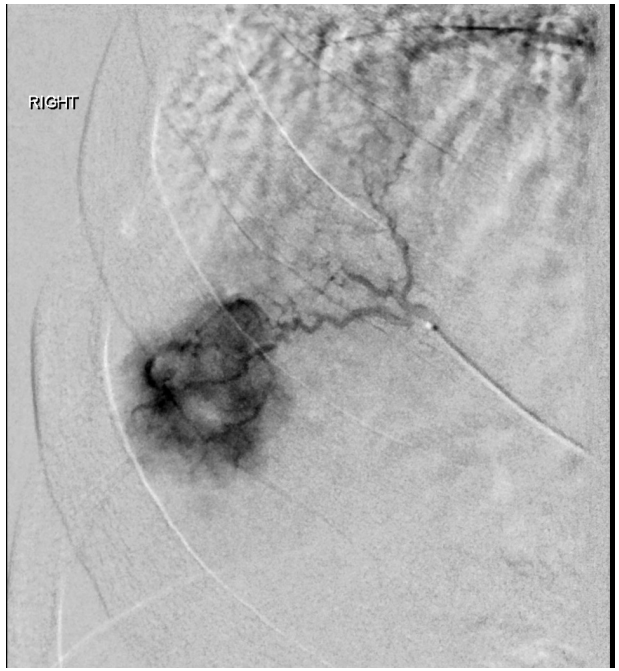
45 mci (250 cc)

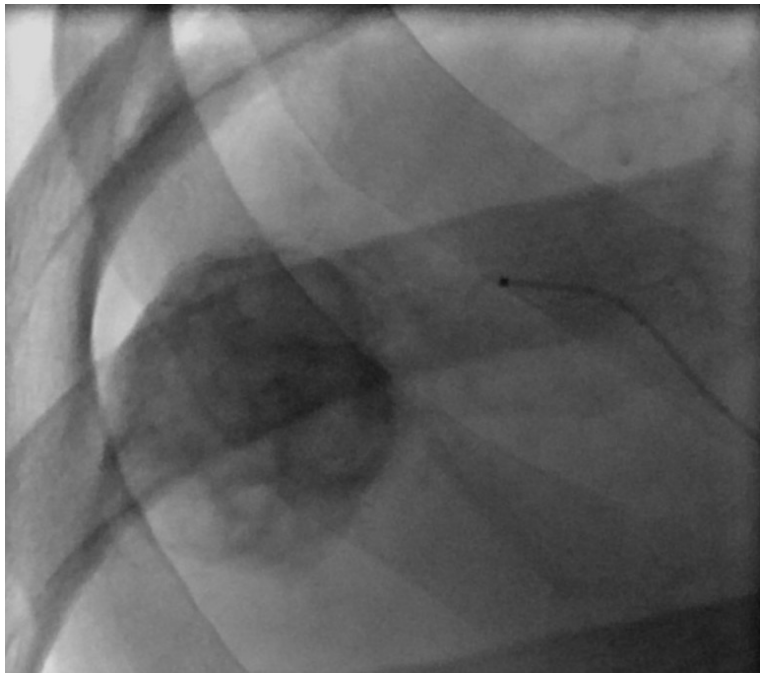
UNC SCHOOL OF MEDICINE



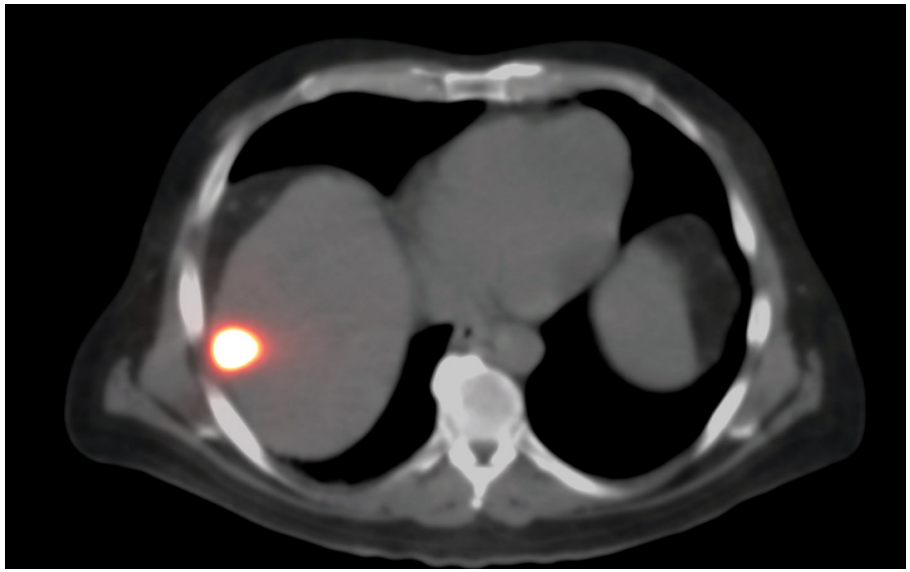
CIO SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

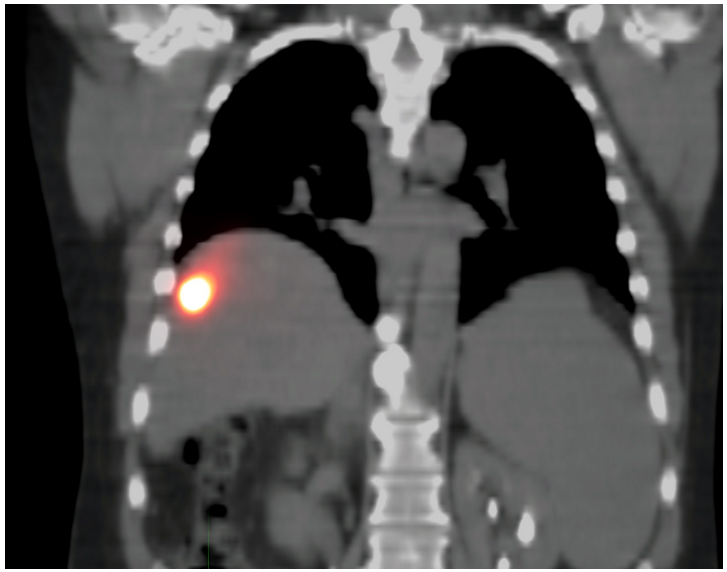
UNC SCHOOL OF MEDICINE Radiology


RIGHT



UNC
SCHOOL OF MEDICINE





CIO
SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC
SCHOOL OF MEDICINE
Radiology

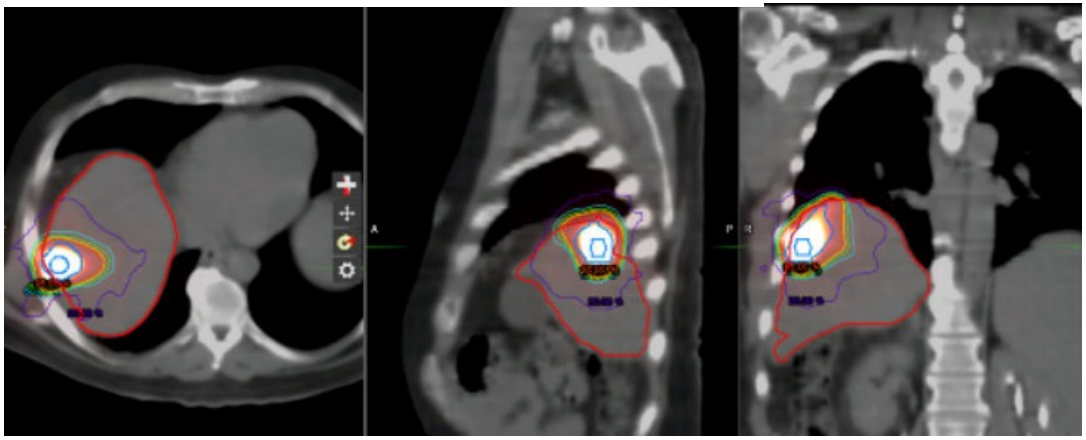
POST Y90 DOSIMETRY ANALYSIS

Intent: Curative
Dosimetry Method: MIRD (ONE AND DONE TRIAL)
Calibration Utilized: 5-day Pre-Cal

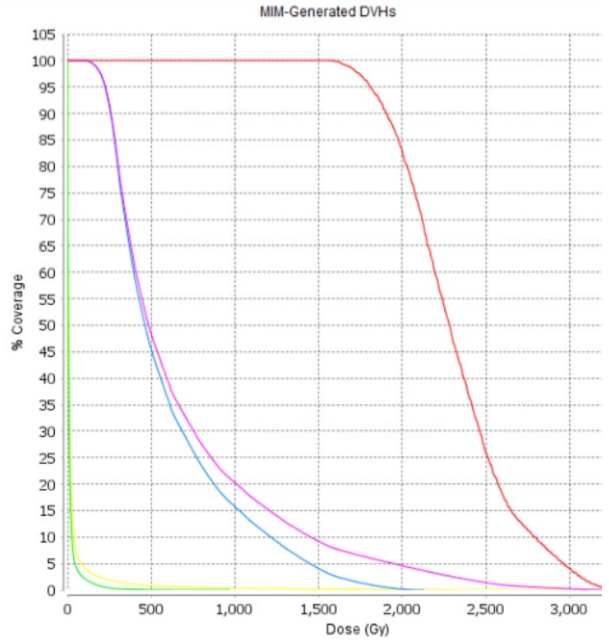
LSF: 5.78%

Total Liver Volume: 2,015 mL
Targeted Angiosome Volume: 33 mL (1.6% of Liver)
Targeted Tumor Volume: 2 mL

Targeted Angiosome Dose: >300 (ONE AND DONE TRIAL PROTOCOL)
Actually Delivered Activity: 33 mCi
Actually Achieved Angiosome Dose: 695 Gy
Actually Achieved Tumor Dose: 2,313 Gy



Y90 Post-Operative Dosimetry Report



Dose ID	Dose Details
D1	LDM with Known Activity Dose (Restricted to Liver)

Contour	Line Style	Max Dose	Min Dose	Mean Dose	SD
	D1	D1	D1	D1	D1
Liver + Extrahepatic Activity		3303.70	0.00	26.86	113.48
Liver_Perfused_Target_I		3303.70	114.52	694.67	543.14
Non-Tumor		2127.50	114.52	603.18	385.93
Normal Liver		968.42	0.00	13.77	33.06
Tumor 1		3303.70	1567.17	2313.12	333.81

SCHOOL OF MEDICINE
Radiology

Glass vs Resin

UNC SCHOOL OF MEDICINE

Devices

- **Glass-Based Microspheres**
  - Deliver higher specific activity per particle with fewer particles
  - Pre-ordered vials
- **Resin-Based Microspheres**
  - Higher particle numbers but with lower specific activity per particle
  - Flexible dosing using mother vial aliquots
- **Comparable outcomes**

FUTURE DIRECTIONS

UNC SCHOOL OF MEDICINE

Streamlined Resin Y90 Radiation Segmentectomy for Small HCC (One&Done)

ClinicalTrials.gov ID NCT06618300

Sponsor UNC Lineberger Comprehensive Cancer Center

Information provided by UNC Lineberger Comprehensive Cancer Center (Responsible Party)

Last Update Posted 2024-11-07

CIO SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology

Conclusion

- **Single-session Y90 is safe, effective, and cost-saving**
- **Promising for small HCCs in selected patients**
- **Potential to transform access in liver cancer care**

SYMPOSIUM ON CLINICAL INTERVENTIONAL ONCOLOGY

UNC SCHOOL OF MEDICINE Radiology