Society of Interventional Oncology

Case of the Month

Liver hypertrophy:
Using Y90 for optimization of future liver remnant

Cynthia De la Garza Ramos, MD, Integrated IR Resident, Mayo Clinic Florida

Robert J. Lewandowski, MD, Professor of Radiology, Northwestern University

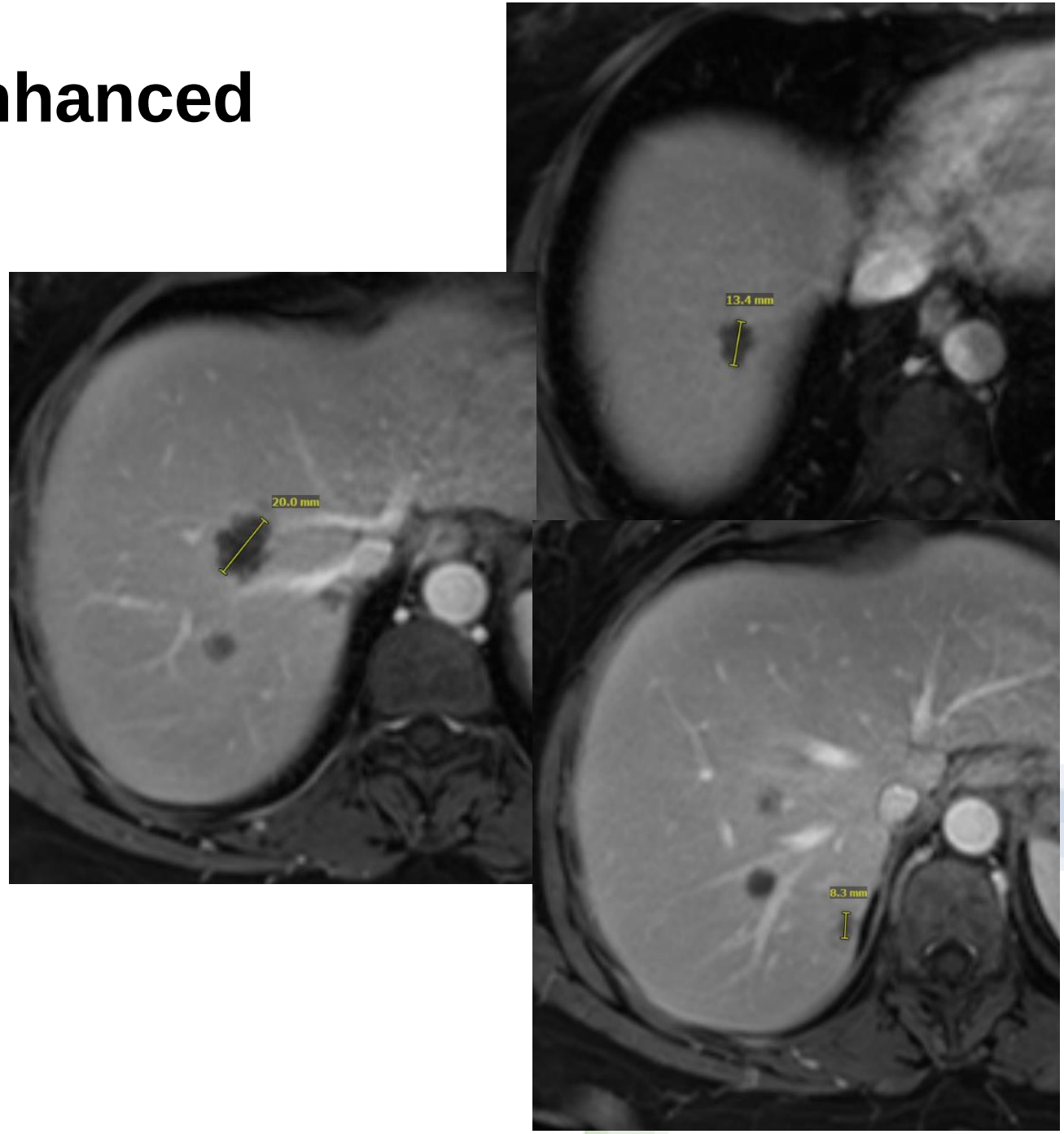
Beau B. Toskich, MD, Professor of Radiology, Mayo Clinic Florida

Clinical presentation

- 46-year-old female with history of synchronous sigmoid **colon cancer and liver metastases**
- Initial treatment:
  - FOLFOX and Avastin
  - Low anterior resection
- Transferred care from outside institution with interest in liver resection
- Hepatic substrate and performance status:
  - ALBI 1
  - Child-Pugh A5
  - ECOG 0

Initial contrast-enhanced MRI and labs

- Multiple right hepatic lobe lesions without suspicious left lobe lesions
- Non-cirrhotic liver morphology
- Normal spleen size
- CEA 51.9 ng/dL
- Platelets 133 x10^9/L



How would you treat this lesion?

Volumetrics were performed to assess candidacy for **right hepatectomy.**

Total liver vol: 1302 cc

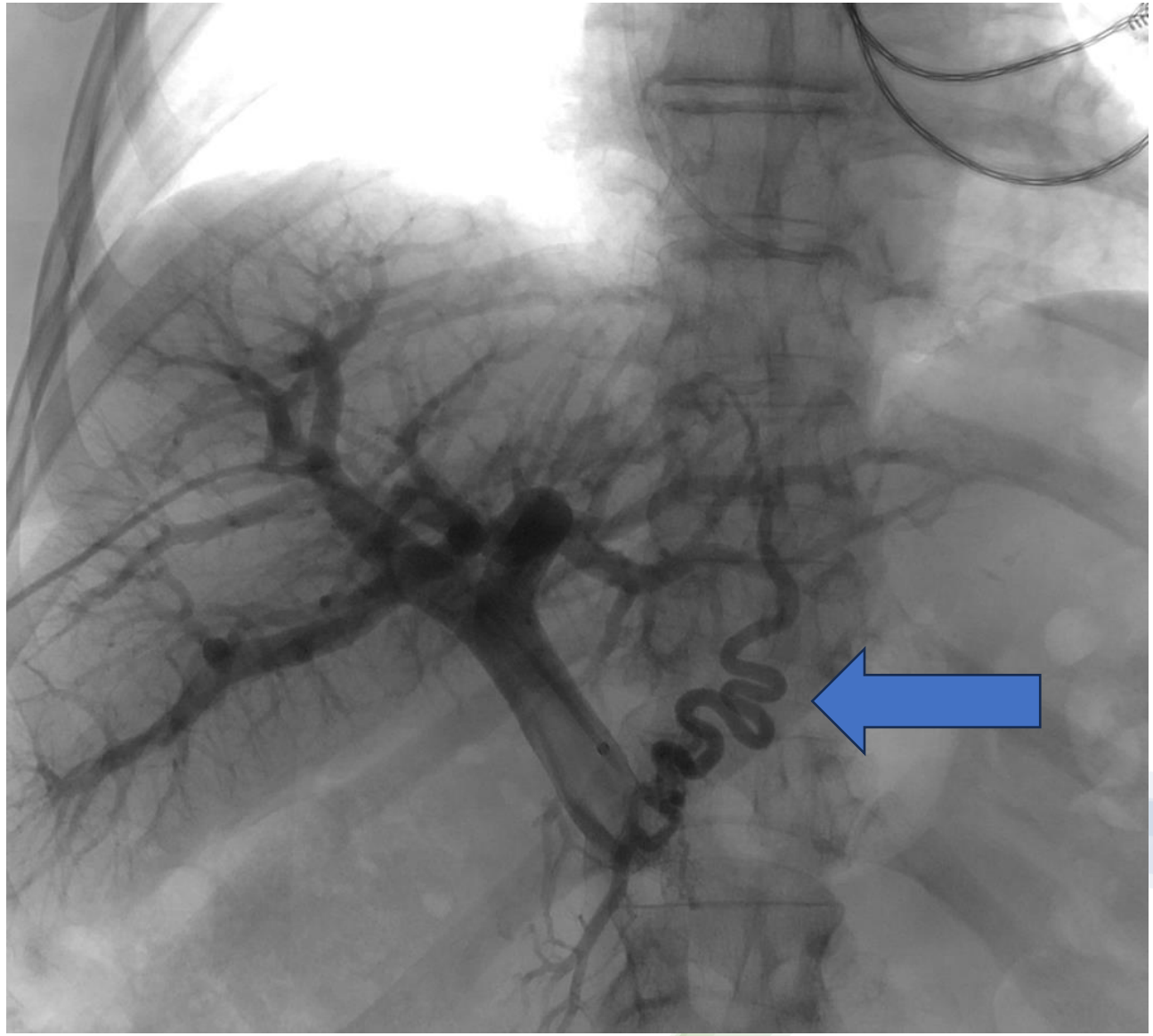
Left lobe: 31%

Right lobe: 69%

Therefore, patient referred to IR for **portal vein embolization (PVE)** for hypertrophy of the left lobe as the future liver remnant (FLR).

Portal venogram

- Main portal venogram demonstrated an enlarged left coronary varix with retrograde flow.
- The corrected sinusoidal pressure gradient was 12 mmHg, consistent with portal hypertension.
- Biopsies demonstrated mild steatosis without fibrosis.
- Given absent risk factors for liver disease other than prior systemic therapy exposure, patient was diagnosed with chemotherapy associated liver injury.



Therefore, PVE not performed.

Next step?

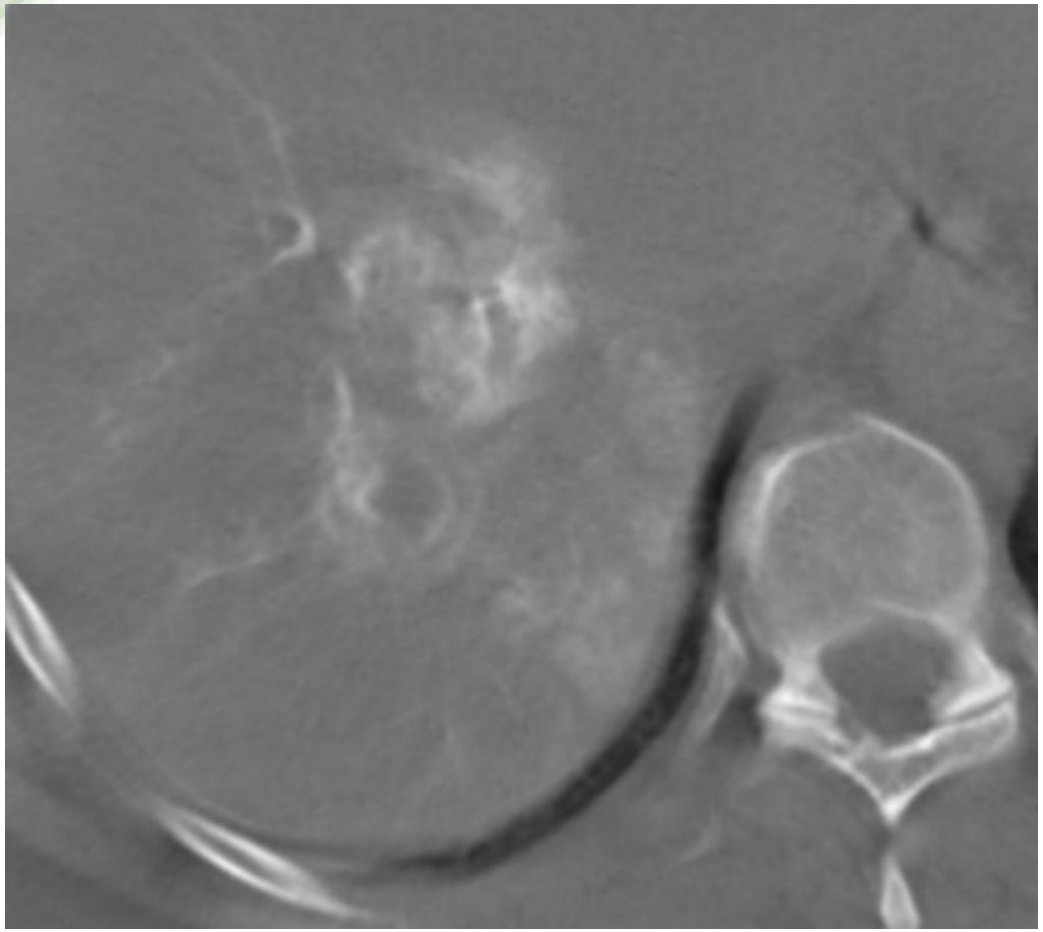
- Multidisciplinary tumor board did not recommend proceeding with **PVE** due to potential for acute aggravation of portal hypertension and decompensation.

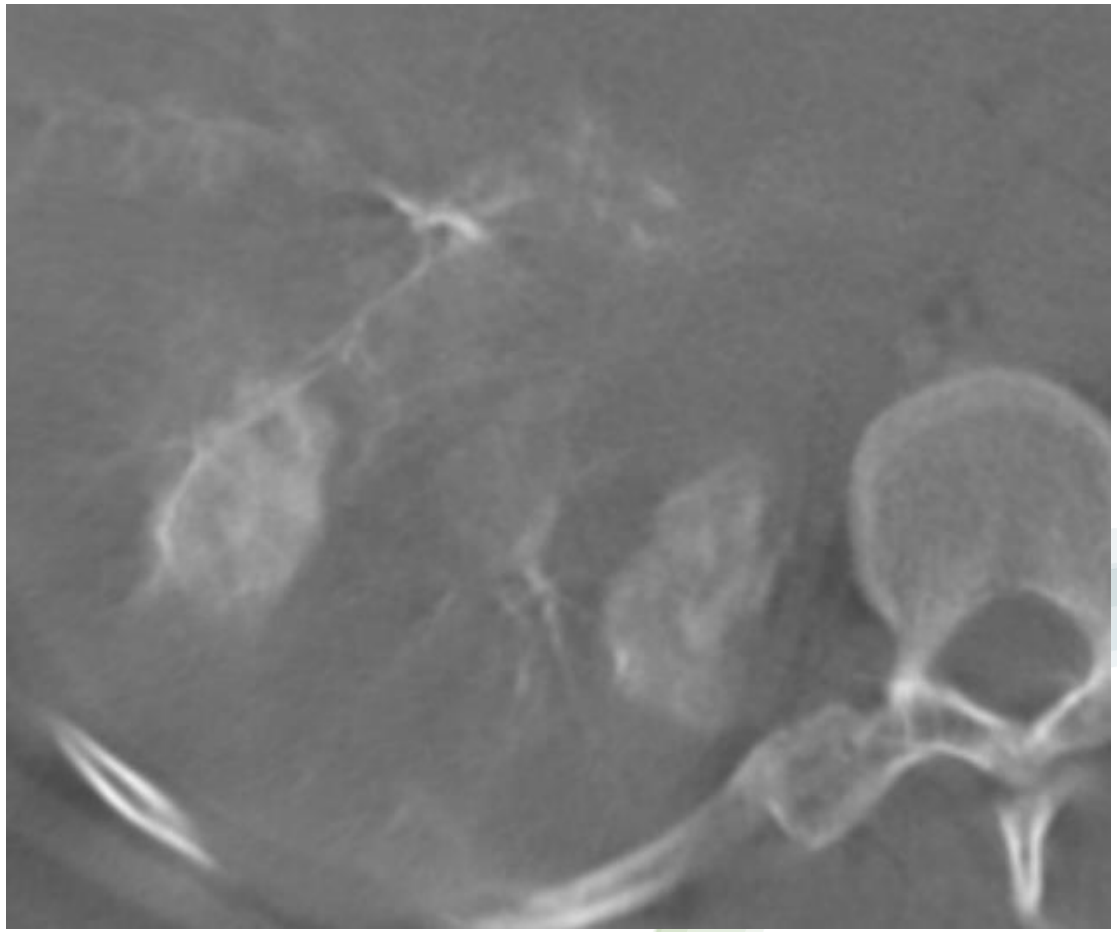
- Discontinuation of chemotherapy was recommended to allow for the liver to recover from injury.

- **Y90 radiation lobectomy** was recommended in lieu of **PVE** due to the slower hypertrophy rate (allowing for liver sinusoidal recovery) and ability to control disease while off systemic treatment.

Y90 radiation lobectomy

At time of mapping and cone beam CT, the right hepatic lobe lesions had increased in size

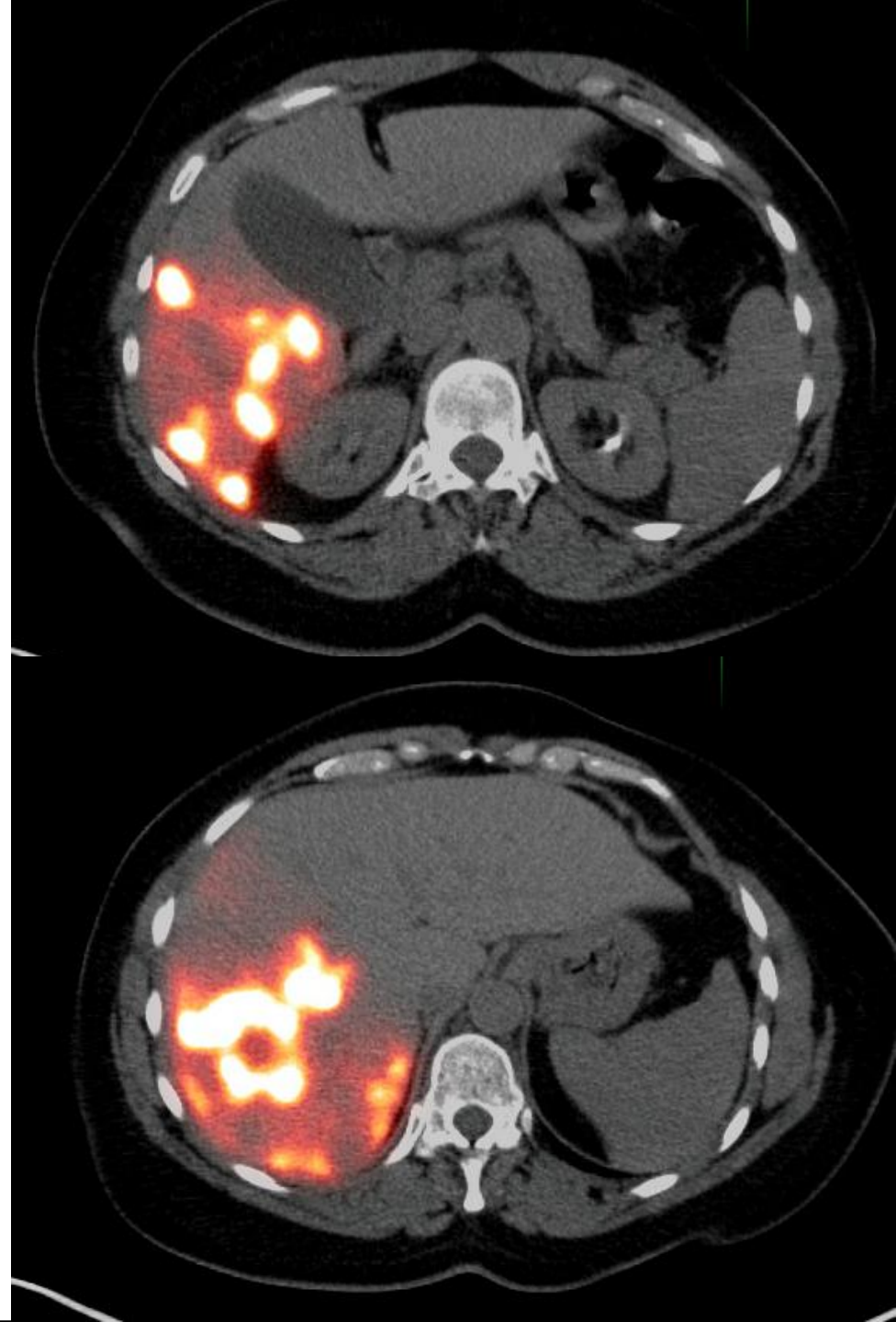




Y90 radiation lobectomy

- Total treatment volume: 938 cc
- Glass microsphere (TheraSphere) delivery via the anterior and posterior divisions of the right hepatic artery and the segment V hepatic artery
- Specific activity: Second week Tuesday
- PET/CT confirmed activity within the tumors and right lobe

Treatment Site	Treatment Vol (cc)	Activity Administered (GBq)	Dose Delivered (Gy)
Anterior	476	1.83	186.9
Posterior	375	1.41	182.2
Seg 5	87	0.29	163.9
Lung			2.7
Total Activity Administered (GBq)		3.59	

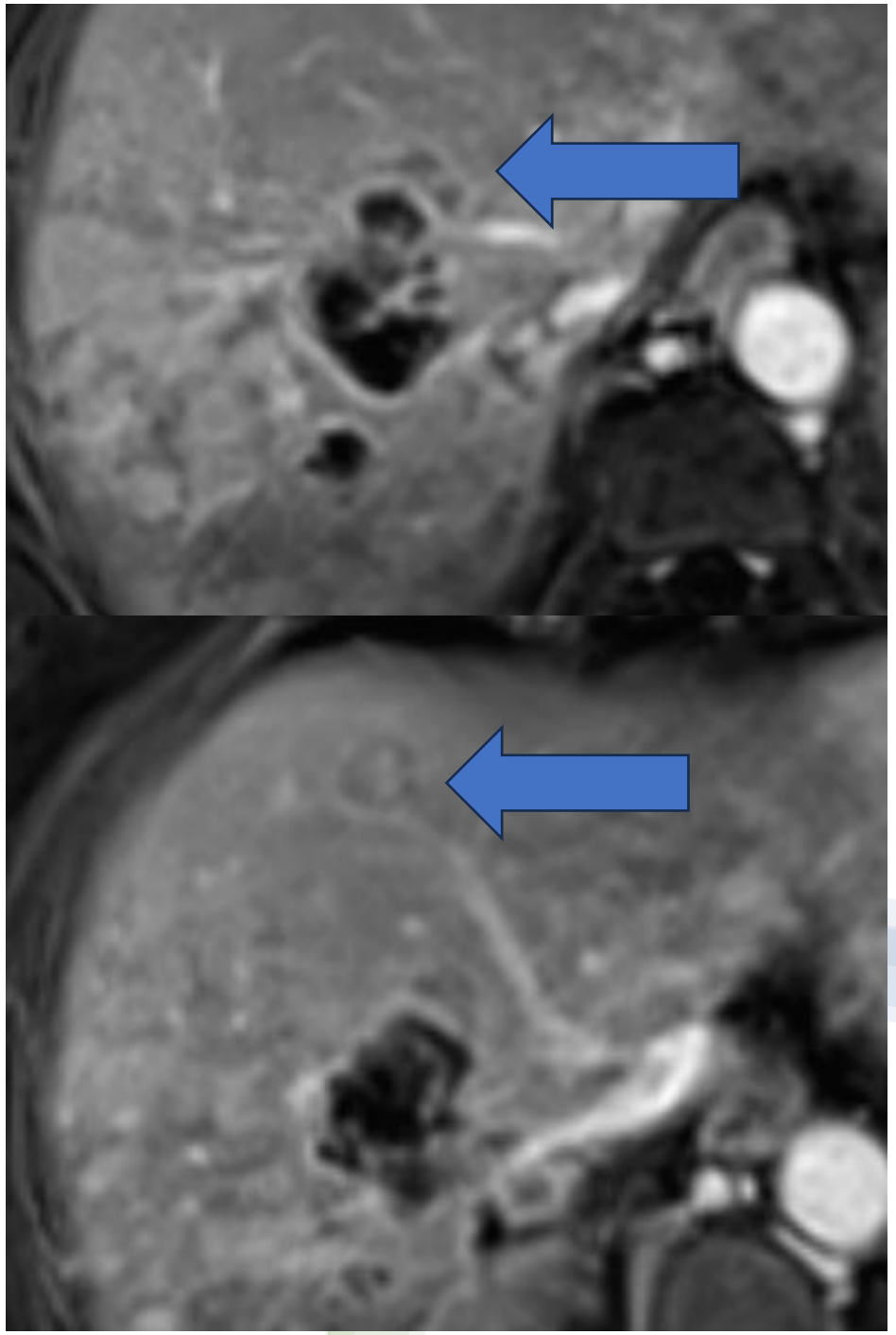


1 month follow-up

- CEA decreased to 12.7 ng/dL
- Contrast-enhanced MRI revealed post radioembolization changes in the right hepatic lobe lesions
- However, there were two new lesions in the junction of segment VIII/IV and IV/II, indicating metastases in the left hepatic lobe.

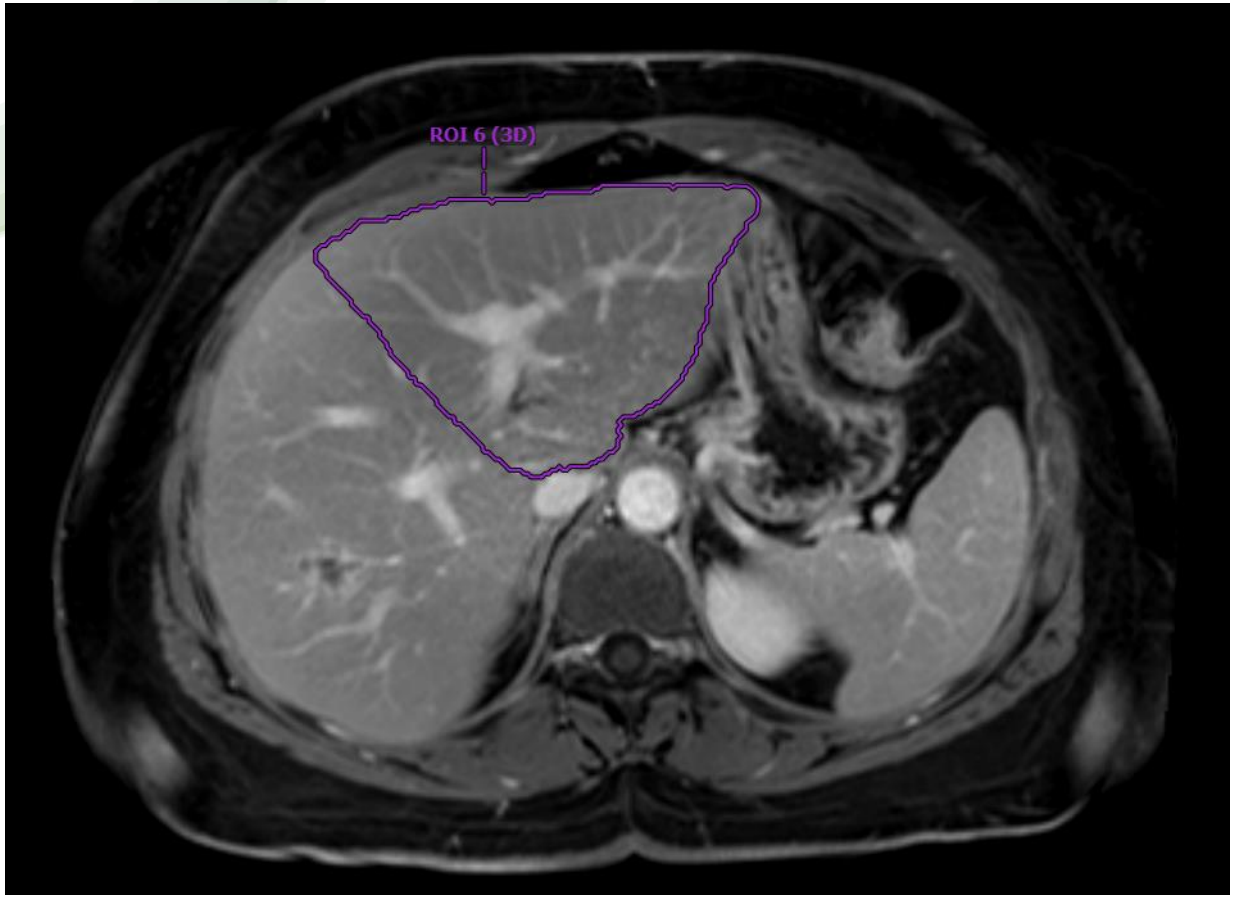
Multidisciplinary decision was made to restart systemic therapy.

- At **3-month** follow-up, an additional left lobe lesion was detected, and surgery is being held until further test of time is completed.



Pre-treatment

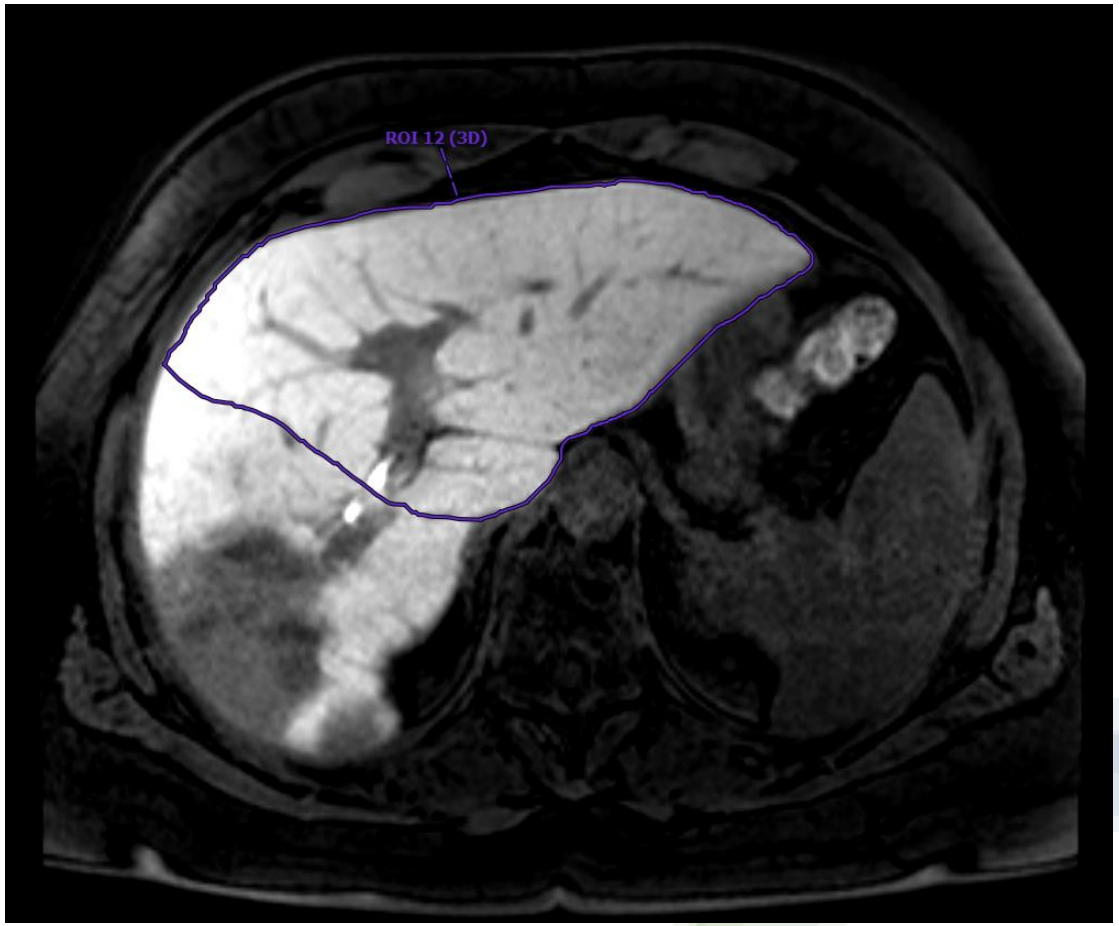
Gadavist MRI delayed phase



FLR 423 cc

3-month follow-up after Y90

Eovist MRI with 20-minute delay



FLR 842 cc
Treated lobe atrophy

Key points: FLR

- In general, the FLR should exceed:
  - 20% in a patient with preserved liver function
  - 30% in a patient undergoing systemic chemotherapy
  - 40% in a patient with underlying liver disease

- PVE and Y90 radiation lobectomy as means of FLR hypertrophy have different mechanisms of action

  - **PVE**
    - Faster hypertrophy rate
    - May potentially lead to tumor growth

  - **Y90 radiation lobectomy**
    - Slower hypertrophy rate
    - More time for sinusoidal recovery after chemotherapy-associated liver injury
    - Increased targeted tumor control
    - Sinusoidal devitalization

Key points: Y90 radiation lobectomy

- Radiation lobectomy delivers low dose radiation to the future resection site of the liver with the aim of treated lobe atrophy and untreated lobe hypertrophy to reduce post-hepatectomy liver failure (PHLF).

- Favored dose threshold for atrophy of the treated lobe: >88 Gy with glass microspheres within the first week of decay. Less is known on this application with other specific activities.

- The regeneration capacity of the untreated lobe is also important, as a more fibrotic liver may be less responsive than a healthy parenchyma.

Key points: Y90 radiation lobectomy

Benefits:

- **Cytoreduction**
  - Compared to PVE, radiation lobectomy offers the additional benefit of local tumor control
- **Devitalizes future resection site**
  - Could provide additional assurance against PHLF
- **Biologic test of time**
  - The effects of Y90 are gradual but could vary based on parameters such as particle number, specific activity, hepatic substrate, and nutritional state of the patient.
  - Assessment of biologic characteristics and risk of recurrence/metastasis may provide value to patients, particularly those at higher risk for complications after resection or disease progression.

Case summary

- In this case, PVE and radiation lobectomy were considered for optimization for hepatectomy
  - PVE was contraindicated due to portal hypertension
  - Y90 was indicated due to adequate mapping and low LSF

- At follow-up, although there was tumor response in the treated lobe, there was evidence of new metastatic disease in the FLR.
  - Therefore, the patient did pass the biologic test of time, and may have progressed if hepatectomy would have been performed up-front.
  - Patient is now being considered for microwave ablation of segment IV lesions.

- A prospective, federally funded, multicenter clinical trial is currently underway to further investigate this promising application of radioembolization (NCT04390724).

References

- Entezari, P., Toskich, B. B., Kim, E., Padia, S., Christopher, D., Sher, A., Thornburg, B., Hohlastos, E. S., Salem, R., Collins, J. D., & Lewandowski, R. J. (2022). Promoting Surgical Resection through Future Liver Remnant Hypertrophy. Radiographics: a review publication of the Radiological Society of North America, Inc, 42(7), 2166–2183.

- Vouche, M., Lewandowski, R. J., Atassi, R., Memon, K., Gates, V. L., Ryu, R. K., Gaba, R. C., Mulcahy, M. F., Baker, T., Sato, K., Hickey, R., Ganger, D., Riaz, A., Fryer, J., Caicedo, J. C., Abecassis, M., Kulik, L., & Salem, R. (2013). Radiation lobectomy: time-dependent analysis of future liver remnant volume in unresectable liver cancer as a bridge to resection. Journal of hepatology, 59(5), 1029–1036.

- Palard, X., Edeline, J., Rolland, Y., Le Sourd, S., Pracht, M., Laffont, S., Lenoir, L., Boudjema, K., Ugen, T., Brun, V., Mesbah, H., Haumont, L. A., Loyer, P., & Garin, E. (2018). Dosimetric parameters predicting contralateral liver hypertrophy after unilobar radioembolization of hepatocellular carcinoma. European journal of nuclear medicine and molecular imaging, 45(3), 392–401.