

# Voxel based dosimetry with Holmium-166: comparison of predicted with post treatment dose of the tumor and the healthy liver.

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# Aims



- SIRT (selective internal radiotherapy) with Holmium: established technique to locally treat tumors in liver, preserving normal liver tissue
- Pre treatment dosimetry can be done by MAA SPECT/CT or Holmium scout SPECT/CT
- Holmium scout has the advantage to use the same microsphere as the treatment and is more realistic in prediction and lung shunt calculation
- aim of the study was to see if the predictive dose from Holmium scout was comparable to (post)treatment dose in tumor and normal liver tissue



# Methods

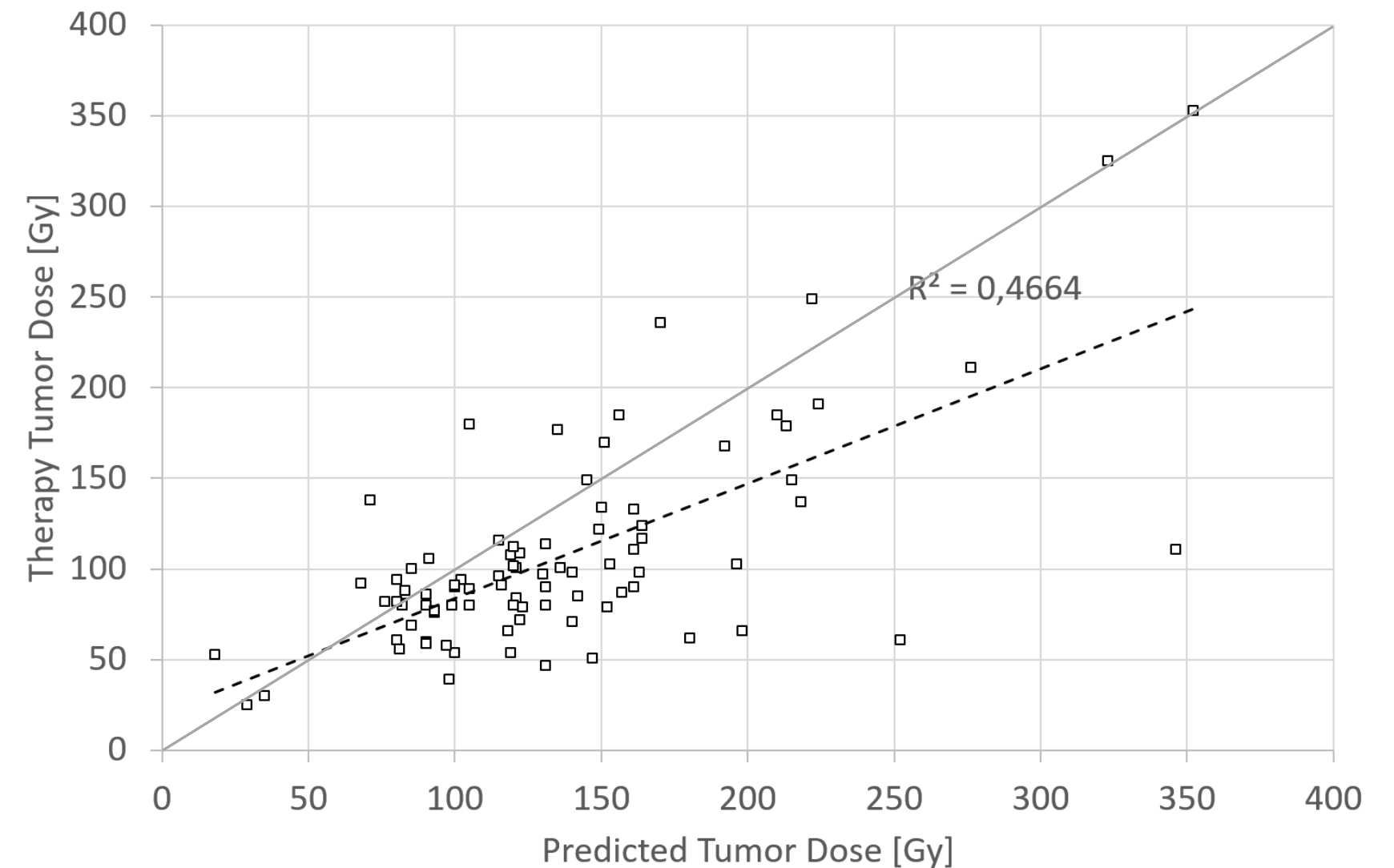
- From 2 hospitals during 2,5 years we treated 52 patients:
  - 25 with HCC (hepatocellular carcinoma)
  - 8 with ICC (intrahepatic cholangiocarcinoma)
  - 11 with mCRC (metastatic colorectal cancer)
  - 8 other types
- Images on Siemens Symbia SPECT/CT, 128x128 matrix, ME collimators, 20 sec in 60 angles
- Scout images on day 0, post-treatment images:
- Doses were calculated with Q-suite, from scout and post-therapy images

| Activity in GBq | days |
|-----------------|------|
| 1               | 2    |
| 2               | 3    |
| 3               | 4    |
| 4               | 4    |
| 5               | 5    |



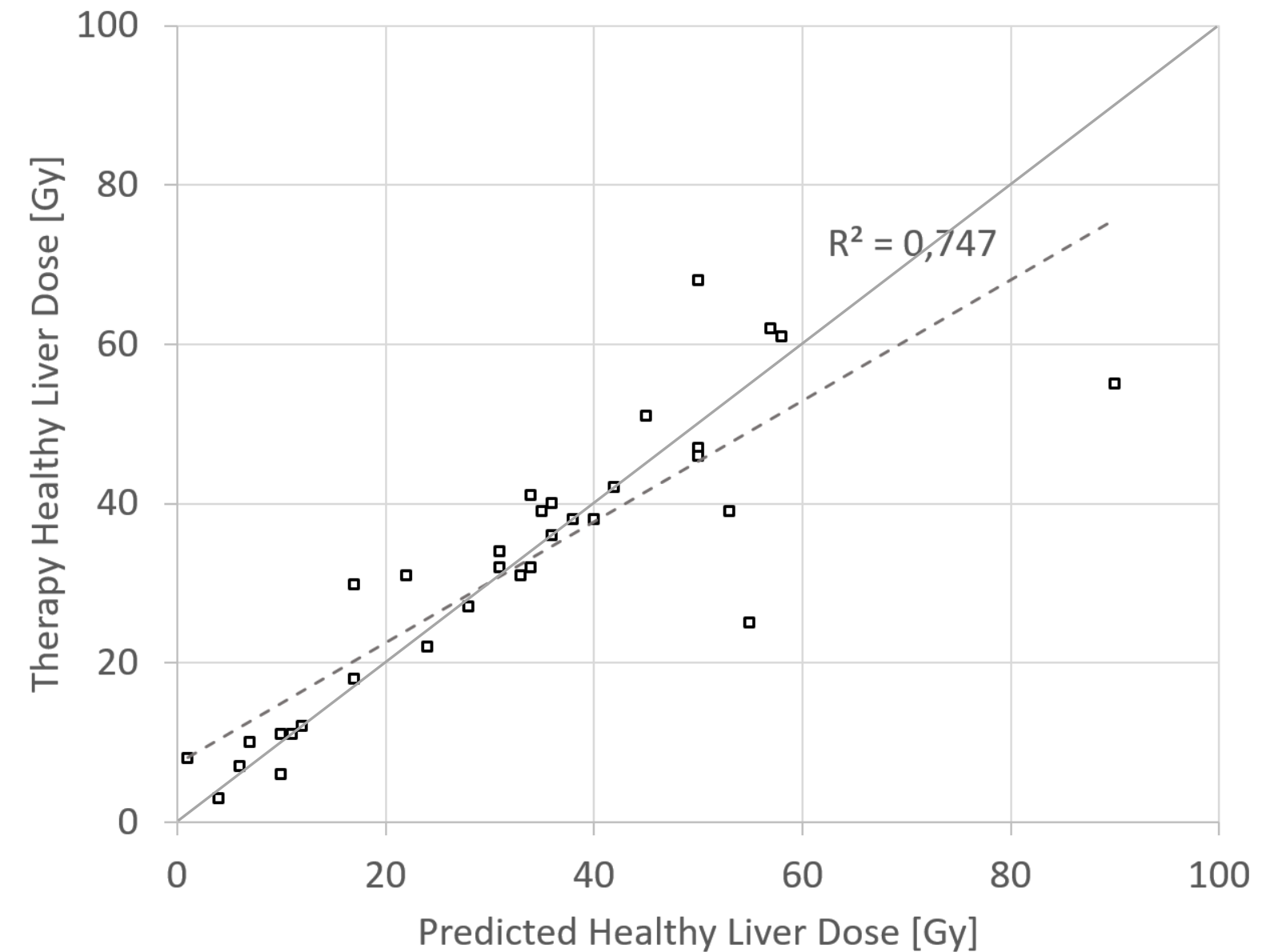
# Results

- Most post-treatment dose were lower than scout doses in tumors ( $R^2 = 0.466$ ,  $r = 0.68$ ,  $p=0.0000$ ).



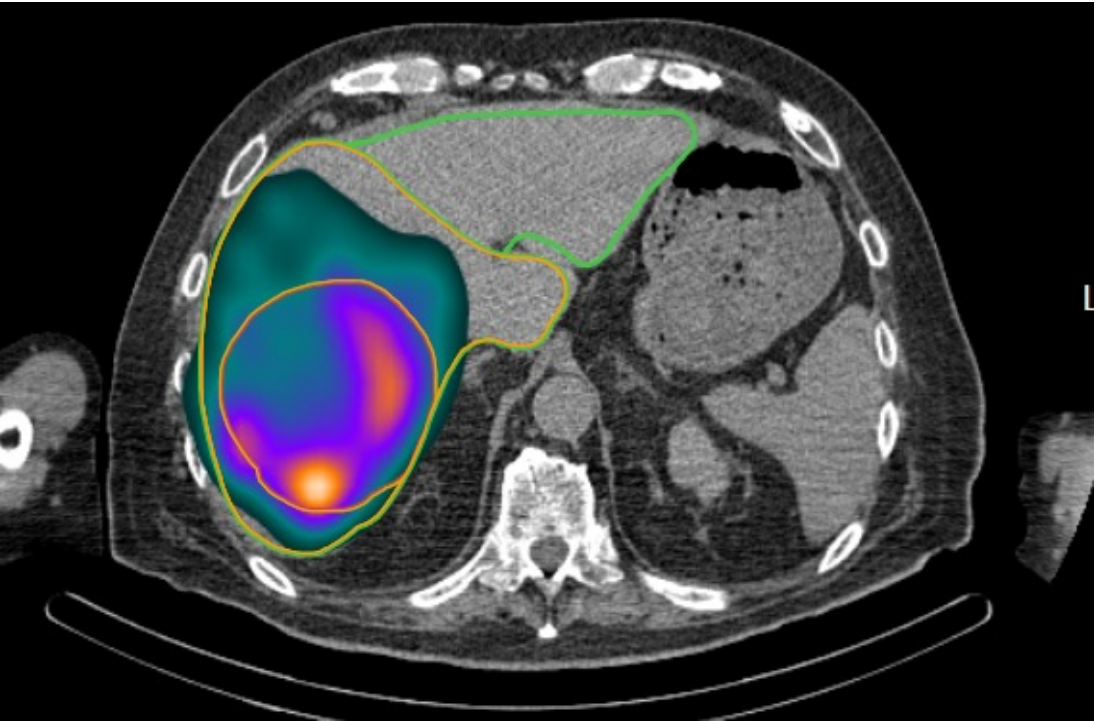
# Results

- The correlation between the predicted and post treatment dose for the healthy liver was high ( $R^2 = 0.747$ ,  $r = 0.86$ ,  $p=0.0000$ ).



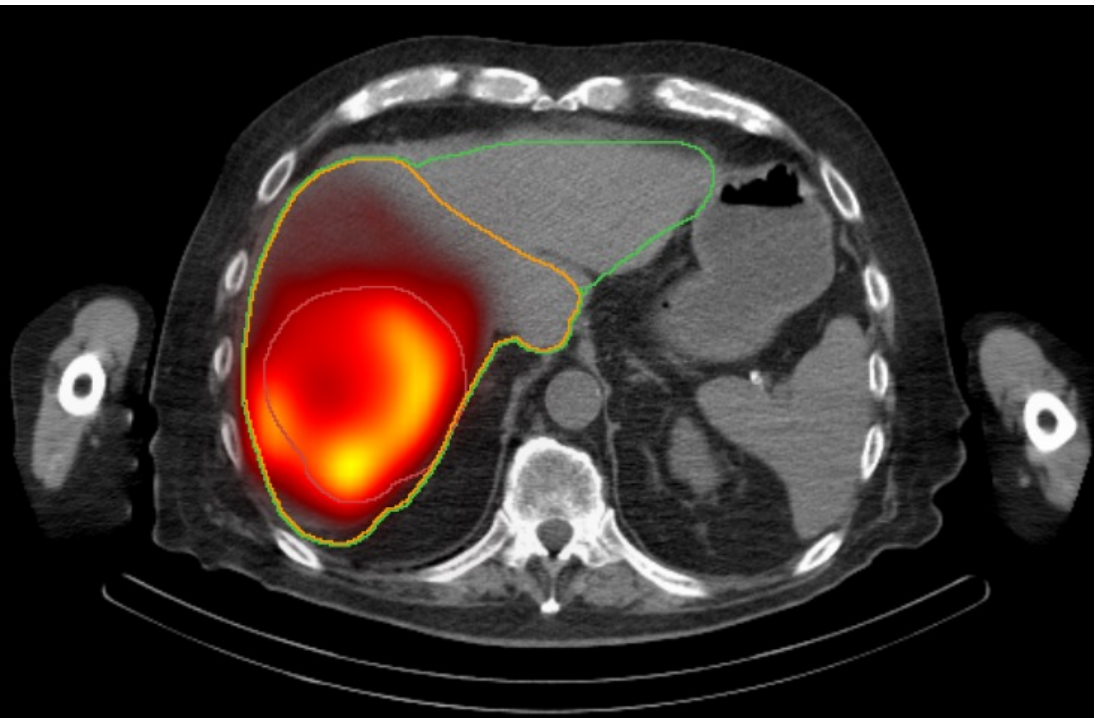
# Good target, good prediction

scout



| VOI                  | Mean dose |
|----------------------|-----------|
| Whole liver          | 41 Gy     |
| Healthy Whole liver  | 28 Gy     |
| Tumor                | 91 Gy     |
| Target liver         | 53 Gy     |
| Healthy Target liver | 39 Gy     |

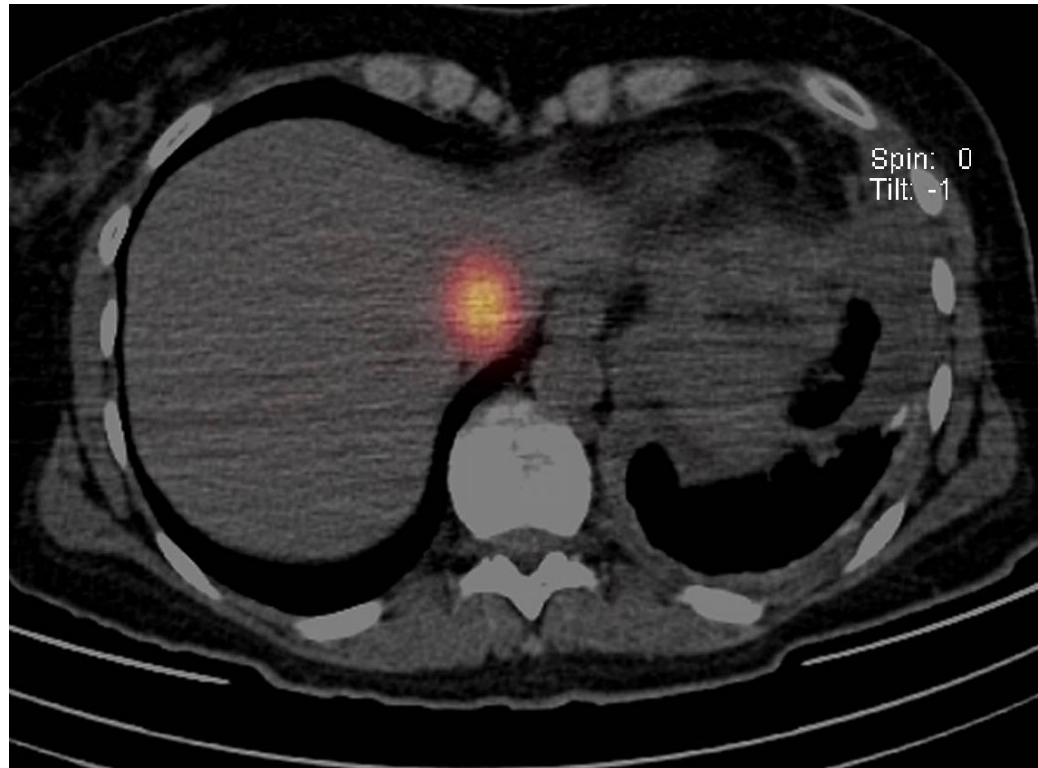
Post-treatment



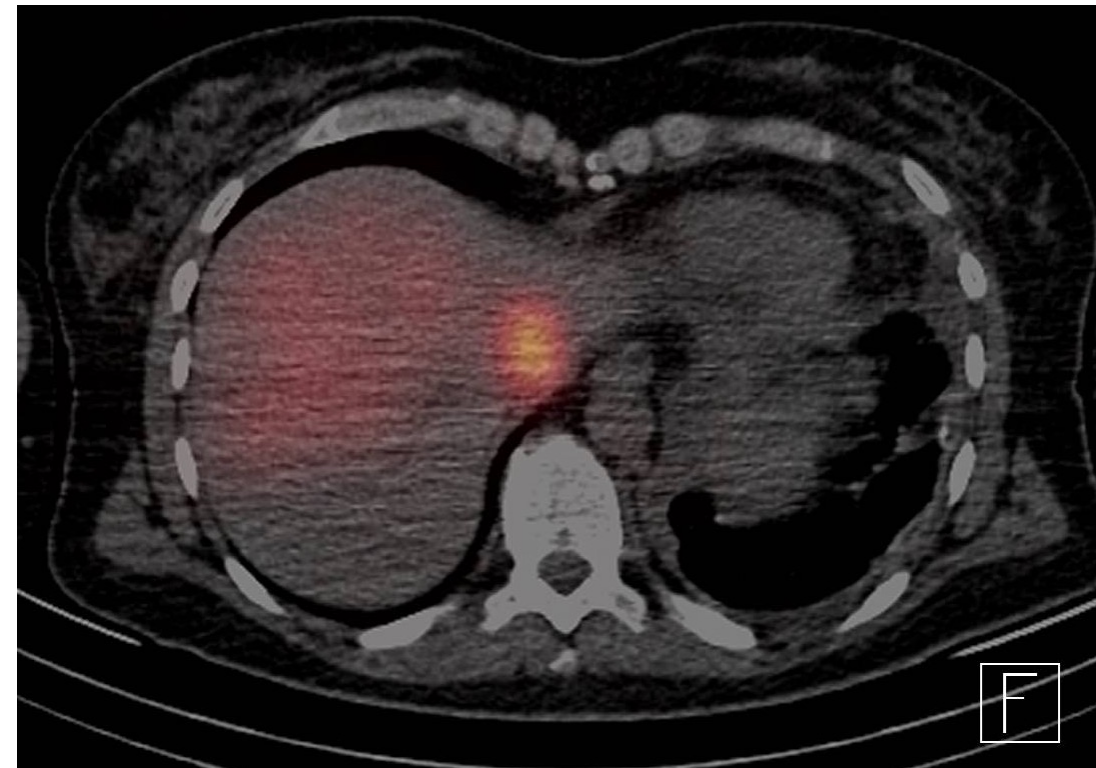
| VOI                    | Mean dose |
|------------------------|-----------|
| ● Whole liver          | 44 Gy     |
| ↪ Healthy Whole liver  | 27 Gy     |
| ● Tumor                | 106 Gy    |
| ● Target liver         | 56 Gy     |
| ↪ Healthy Target liver | 37 Gy     |



# Different injection position

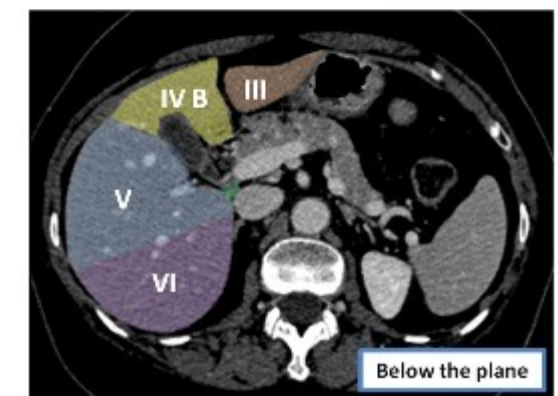
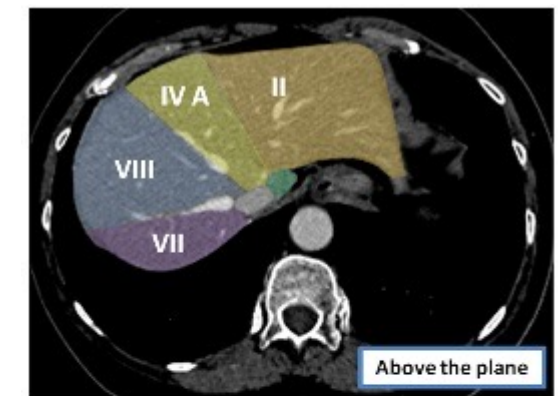


Scout > 300 Gy



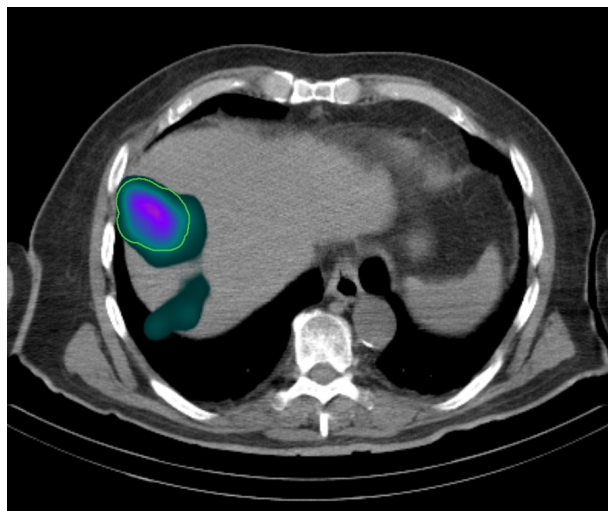
Post-treatment: 111 Gy  
Injection just before the ostium/bifurcation of segment IVa-1 due to spasm of superselective arterial feeder of the tumor

Or: Back or overflow: spil of activity during treatment because of larger volume



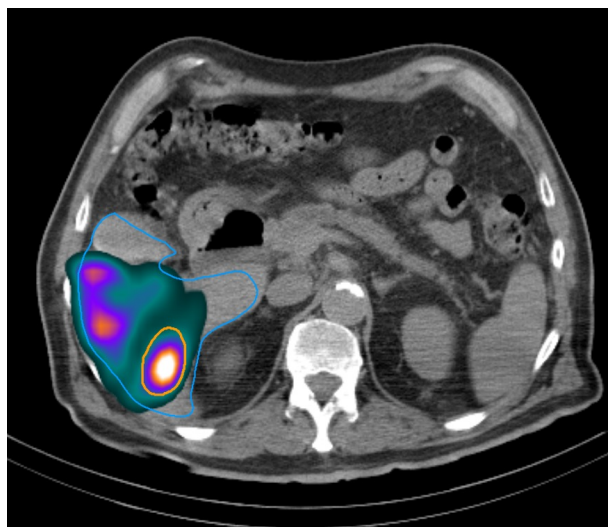
# HCC in S 6 and 8

Selective to S 8  
Progreat 2,4 French  
microcatheter



100 Gy

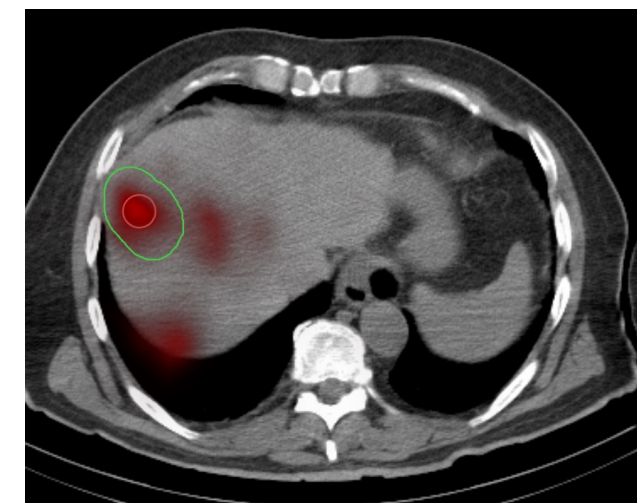
Selective to S 6  
Progreat 2,4 French  
Microcatheter:  
Small arterial injury



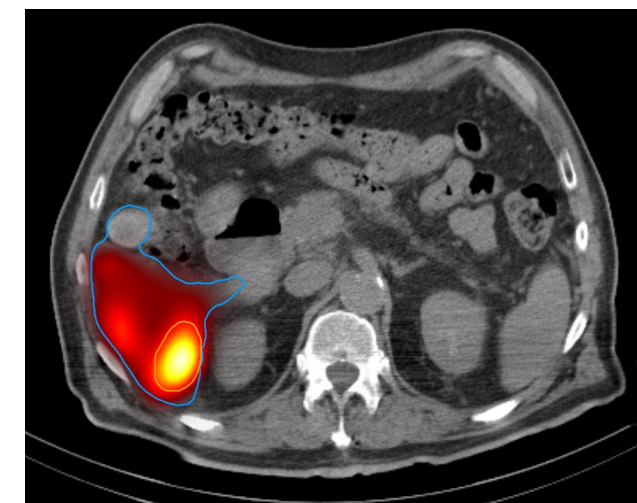
scout

170 Gy

Superselective to S 6  
Progreat 1,9 French  
microcatheter



green zone: 54 Gy  
red zone: 85 Gy  
Overflow?

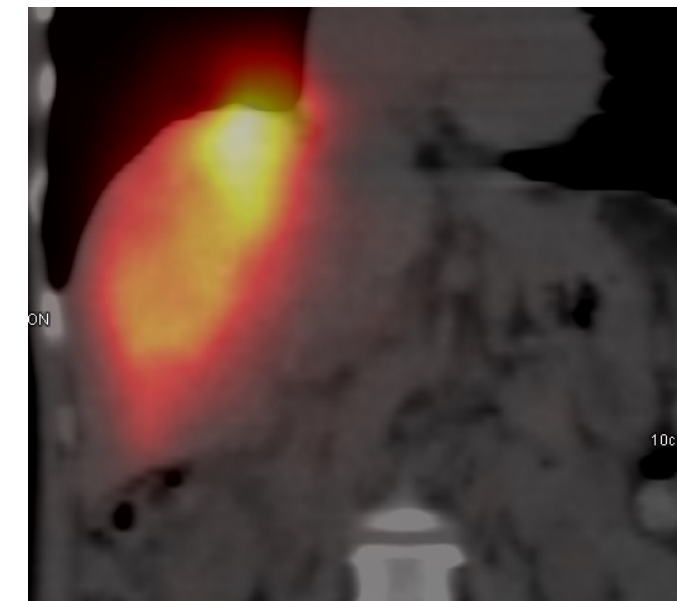
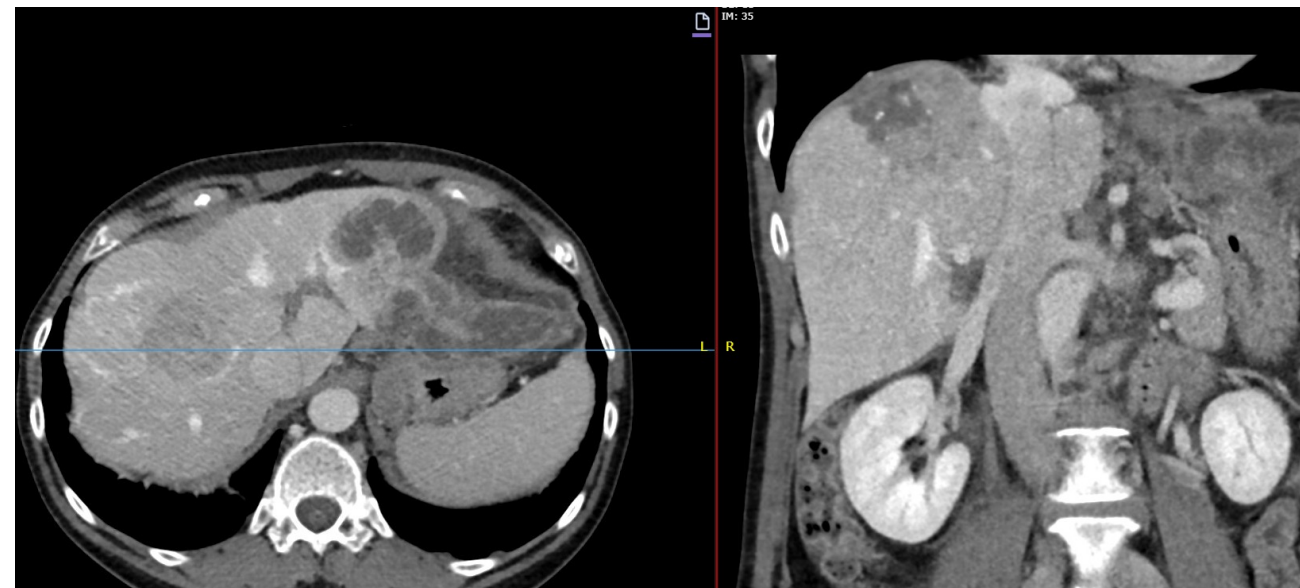
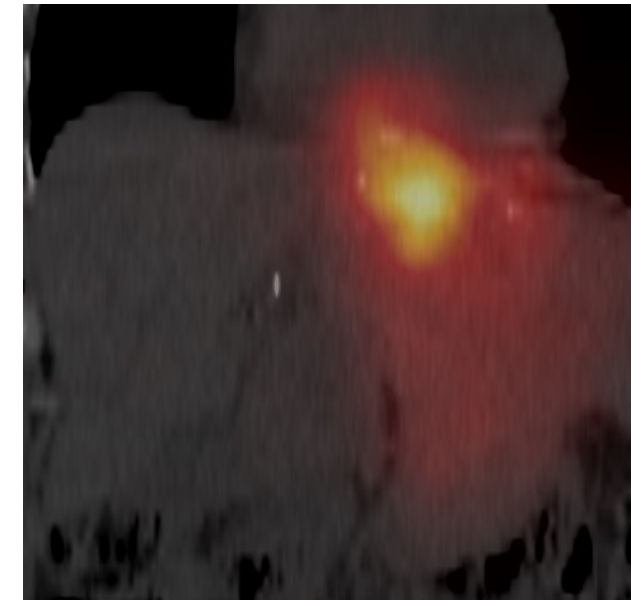
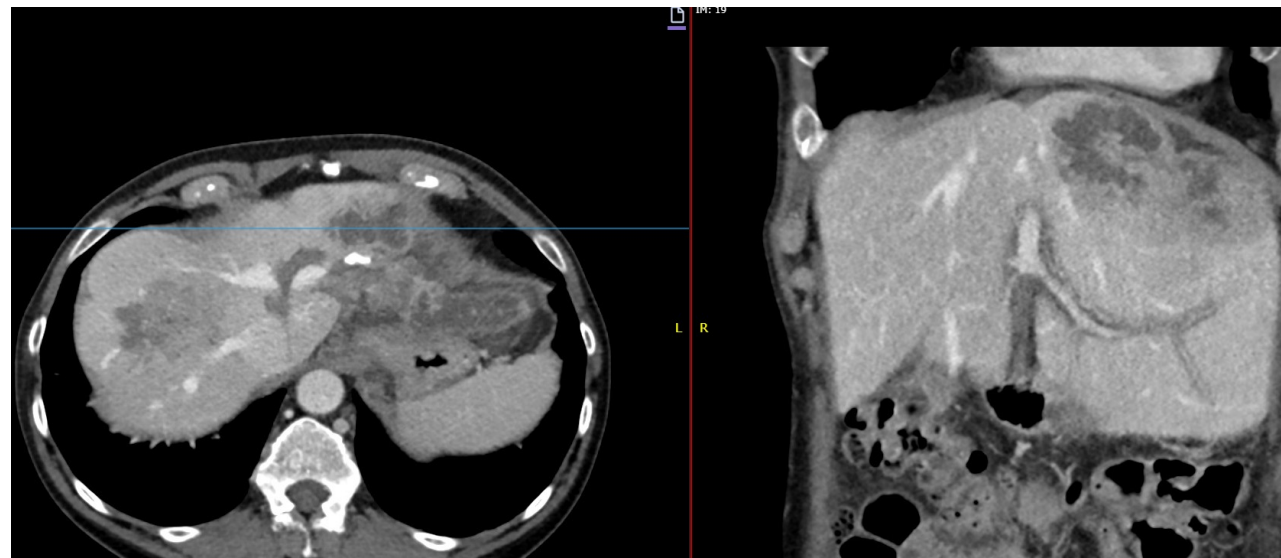


236 Gy

Post-treatment



# Difficult targetting and volume delineation



# Discussion 1/2

Why are there differences?

1. Physiological circumstances in fluid/circulation is not the same
2. Catheter position is not 100% the same
3. Injected quantity of microspheres during scout and therapy are not the same
4. Tumor volumes are sometimes small and create easy disagreement (if VOI is small) between scout and post-therapy images
5. Fusion mistakes between diagnostic image (MRI!) and SPECT/CT: maybe a call to use SPECT/CT with contrast?



# Discussion 2/2

1. Avoid injection closely to bifurcation
2. Catheter position should be 100% the same: take the time to multiple check before injection, even after connecting to the box
3. Have insight on the impact of ordered activity to the amount of microspheres over the perfused and tumor volume (after bevacizumab, poor vascular bed, go for more spec, activity per particle in glass microspheres)
4. Avoid multiple fusion steps between modalities, every step can cause mistakes
5. Small tumors for radiation segmentectomy: calculate perfused volume, better than tumor volume



# Conclusions

- Holmium scout is a safe and reliable way to predict dose before SIRT with Holmium
- Predicted dose for the healthy liver was accurate
- Predicted doses for tumors are sometimes being slightly overestimated

