Accuracy and Safety of Scout Dose Y90 for Personalized Selective Internal Radiation Therapy Planning

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Background

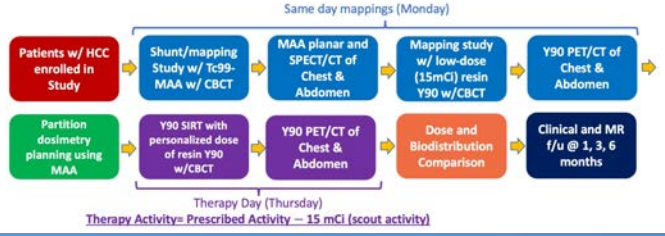
Technetium-99m macroaggregated albumin (**Tc99m MAA**) is an **imperfect/flawed surrogate for yttrium-90 (Y90) biodistribution** in the lungs and liver. **Tc99 MAA** can **overestimates** lung shunt fraction (**LSF**) and tumor-to-normal ratio (**TNR**) of activity compared to that of Y90. [1-5] This can result in inaccurate treatment planning for Y90 SIRT which result in suboptimal treatment response and treatment related toxicity.

Objectives

To evaluate the **accuracy and safety** of **scout/low dose Y90 resin microspheres vs. Tc99m MAA** in predicting the therapeutic dose Y90 biodistribution for personalized Selective Internal Radiation Therapy (SIRT) planning for hepatocellular carcinoma (HCC)

Methods

Prospective single-arm clinical trial (**NCT04172714**) of **N=30 patients** with HCC undergoing Y90 SIRT. Each patient underwent mapping angiography and **MAA SPECT/CT** followed by same-day mapping using **15 mCi Y90 resin microspheres** and **Y90 PET/CT.** During MAA mapping, cone beam CT (**CBCT**) was used to detect and treat potential non-target embolization pre-MAA administration. Partition model was used for treatment planning using MAA data with the **goal of >200 Gy to the tumors**. **Prescribed Y90 activity minus previously administered scout activity** was administered 3 days post mappings. Same microcatheter type and administration position were used for all stages of the study (including CBCT) in each patient. Sureplan®(MIM Software, Cleveland, OH) was used for biodistribution analysis. Please see **study flow chart** below.



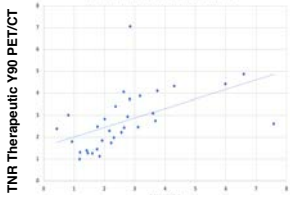
Mean LSF and TNR were **compared** between **the MAA SPECT/CT**, **scout dose Y90 PET/CT**, and **therapeutic dose Y90 PET/CT** (**paired t-test**). **Linear correlation** of **LSF** and **TNR** between **Tc99m MAA** and **therapeutic dose Y90**, as well as **scout dose Y90**, and **therapeutic dose Y90** values were compared (**Pearson's Correlation**). The **safety of scout dose** resin microsphere was evaluated by determining **non-target embolization** seen **on scout dose Y90 PET** which was **not detected** and treated during **mapping CBCT** and discrepancy in extrahepatic activity between MAA SPECT/CT and scout dose Y90 PET/CT. **Embolic effect** of the scout dose was evaluated using **degree of enhancement** in the tumor and non-tumoral liver **pre and post Y90 scout dose.**

Results

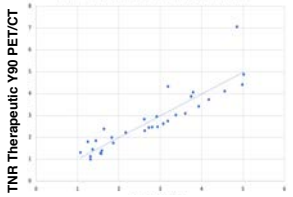
N=30 patients, 33 treated tumors were treated (mean tumor volume: 44.9 cc). There was **no difference for mean LSF and TNR between surrogates.**

	MAA SPECT/CT	Scout Dose Y90 PET/CT	Therapeutic Dose Y90 PET/CT	p-values
Mean LSF	5.7%	6.4%	5.2%	p's>0.05
Mean TNR	2.67	2.75	2.71	p's>0.05

Greater linear correlation of **TNR** between **scout dose and therapeutic dose Y90 (r=0.816)**, compared to **MAA and therapeutic dose Y90 (r=0.531).** Graphs below depict linear correlation between Y90 scout dose and MAA with therapeutic Y90 respectively.



TNR Tc99m MAA SPECT/CT



TNR Scout Dose Y90 PET/CT

TNR	r	p-value	Correlation
MAA vs. **High Dose** Y90 **PET**	0.531	**0.001**	Moderate
Scout Dose Y90 **PET** vs. **High Dose** Y90 **PET**	0.816	**<0.001**	High

Greater linear correlation of **LSF** between **scout dose and therapeutic dose Y90 (r=0.562)**, compared to **MAA and therapeutic dose Y90 (r=0.394).**

LSF	r	p-value	Correlation
MAA vs. **High Dose** Y90 **PET**	0.394	**0.031**	Low
Scout Dose Y90 **PET** vs. **High Dose** Y90 **PET**	0.562	**0.001**	Moderate

Two right gastric arteries were embolized prophylactically to prevent non-target embolization based CBCT findings during mapping. **No extra-hepatic non-target embolization was seen.** Specifically, there was **no discrepancy between extrahepatic activity seen on MAA SPECT/CT and scout dose Y90 PET/CT. CBCT from microcatheter location for administration of scout dose Y90 predicted its distribution 100% of the time.**

The degree of **tumor enhancement was mildly decreased post scout dose Y90** (mean Hounsfield Unit (HU) pre scout: 589 vs. post scout: 483; p<0.001). The degree of enhancement for **non-tumoral liver** in the perfused area of CBCT remained **unchanged** between baseline (mean HU: 243) and post scout (mean HU: 233; p=0.464). Individual tumor enhancement pre an post Y90 scout dose depicted below.

Conclusions

1. **Scout dose Y90 is a safe and accurate surrogate for SIRT planning.**
2. **Scout dose Y90 is more accurate than MAA** for prospective therapy planning.
3. **15 mCi 3-day pre-calibrated resin microsphere** was safe and effective with no gross embolic effect or non-target embolization.
4. **Similar results should be confirmed with glass-based Y90 microspheres.**

References

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