



Treatment of Unresectable Hepatic Metastases With Yttrium-90 Microspheres: Correlation of Dosimetric Parameters With Clinical Outcomes

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Purpose

Yttrium-90 (Y-90) microspheres have been increasingly employed to provide local therapy for the treatment of unresectable hepatic metastases. In this study, we examine whether dosimetry related factors such as delivered activity can serve as suitable prognostic indicators of clinical outcomes including overall survival (OS) and progression-free survival (PFS).

Methods

Between October 2010 and March 2016, 31 patients with hepatic metastases treated with Y-90 radio-embolization were included in this retrospective study. Patients were included if they had received Y-90 infusion with documented radiation activity delivered to both hepatic lobes, documented pulmonary shunt as well as documented radiation activity to the lungs from Y-90 uptake. Treatment dose (in the range 100–150 Gy) was prescribed and the corresponding activity required to deliver such a dose was calculated. OS and PFS probabilities were determined from each subject's date of the Y-90 procedure to the last follow-up date using Kaplan-Meier actuarial analysis. Median Y-90 activity administered, pulmonary shunt, and resulting lung activity were calculated. Patients were stratified into high and low groups with respect to each parameter's median value. Statistical differences of OS and PFS between the two groups were compared using log-rank test.

Results

All tumors were metastatic with the most common primary site as colon adenocarcinoma (68.8%). The median follow-up time was 10.5 months. The median activity delivered was 40.8 ± 22.3 mCi. 15 patients received activity higher than the median value (46.3 ± 23.4 mCi) and 16 patients received lower activity (30.1 ± 7.5 mCi, $p < 0.001$). A significantly higher median PFS was observed with higher activity compared to lower activity (25.7 ± 3.2 vs. 13.0 ± 3.7 months, $p = 0.03$). There was a trend that higher activity showed improved median OS (28.4 ± 3.7 vs. 10.8 ± 3.6 months, $p = 0.068$). The median OS for high activity was 80.8 % and 57.1 % for low activity. High pulmonary shunt ($7.8 \pm 1.5\%$, $n = 15$) and low pulmonary shunt ($4.1 \pm 1.1\%$, $n = 16$) had insignificant difference on the median OS (17.0 ± 3.6 vs. 28.2 ± 4.4 months, $p = 0.39$) and median PFS (17.5 ± 2.9 vs. 12.4 ± 4.0 months, $p = 0.92$). Similarly, high lung activity (4.0 ± 2.8 mCi, $n = 15$) and low lung activity (1.3 ± 0.3 mCi, $n = 16$) did not show significant difference on the median OS (17.0 ± 3.2 vs. 12.4 ± 4.4 months, $p = 0.42$) and median PFS (17.5 ± 2.7 vs. 10.8 ± 4.2 months, $p = 0.99$).

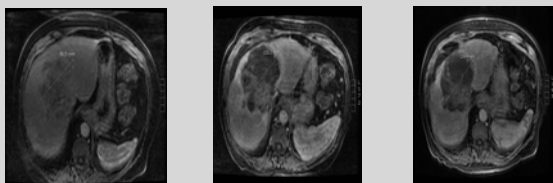


Fig 1: Serial MRI Abdomen Response after 1 year with Cholangiocarcinoma status post SIRT (Selective Internal Radiation Therapy) treatment

Results

Table 1 : List of patients, Group 1: patients received lower doses, and Group 2, patients received higher doses.

Patient	Group	Pulmonary Shunt	Total Activity (mCi)	Total Lung Activity (mCi)	Progression Yes (1), No (0)	Last Follow-up (months)	Alive (0) Dead (1)
1	1	7.0%	33.6	-	-	35.1	1
2	1	3.8%	24.7	1.2	1	5.3	1
3	1	7.4%	36.0	2.3	0	2.5	1
4	1	9.0%	27.2	3.8	1	17.5	1
5	1	5.4%	26.5	1.3	1	9.1	1
6	1	3.5%	39.2	1.3	1	9.3	0
7	1	3.1%	29.2	0.9	1	6.5	0
8	1	7.5%	7.2	0.6	-	0.1	0
9	1	4.0%	40.5	1.5	1	40.7	0
10	1	2.7%	37.0	1.0	1	12.4	1
11	1	10.0%	34.6	3.6	1	2.3	1
12	1	5.4%	29.3	1.5	1	10.8	1
13	1	6.0%	30.9	1.8	1	7.4	1
14	1	5.5%	40.1	2.2	0	1.7	1
15	1	2.7%	33.0	0.8	-	4.5	0
16	1	5.8%	27.7	1.6	0	10.5	0
17	2	8.2%	115.7	12.9	0	17.0	1
18	2	8.7%	81.6	6.1	-	1.7	1
19	2	8.3%	117.0	8.4	-	29.3	1
20	2	5.3%	51.7	2.1	-	7.0	0
21	2	9.5%	46.4	3.7	1	11.9	0
22	2	6.9%	56.2	2.5	-	15.3	1
23	2	2.4%	42.5	1.0	1	28.2	1
24	2	4.2%	42.2	1.8	-	1.1	0
25	2	3.3%	46.2	1.4	0	38.5	0
26	2	5.5%	41.2	2.3	-	3.3	0
27	2	3.1%	47.6	1.4	1	28.4	1
28	2	5.8%	43.8	2.2	0	6.1	1
29	2	6.9%	55.3	2.5	1	23.4	0
30	2	5.0%	51.4	2.4	1	15.7	0
31	2	10.6%	42.1	4.2	0	17.4	0

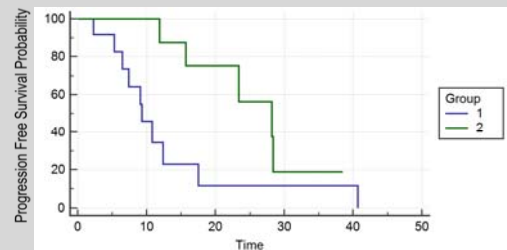


Fig.2 : Kaplan-Meier Survival curves for patients with higher (group 2) and lower doses (group 1), $P=0.03$

Conclusion

Our results suggest that the total radiation activity given to the patients could potentially serve as an indicator of PFS. More patients needed to be included in a future analysis to determine whether total activity could also be used as OS indicator. Other treatment related factors such as lung activity and pulmonary shunt did not correlate with OS and PFS.

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