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Evaluation of the Effectiveness of Radioembolization Therapy in Colorectal Cancer Liver Metastases

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Abstract: Colorectal cancer (CRC) ranks among the foremost causes of cancer-related mortality, with colorectal liver metastases (CLM) considerably affecting prognosis. While surgery is the gold standard for curative treatment, most patients are ineligible due to disease extent or comorbidities. Radioembolization with yttrium-90 (Y-90) microspheres has emerged as a promising locoregional therapy for unresectable CLM. However, its effectiveness in improving survival and tumor control remains an area of active investigation. The clinical results of 59 colorectal cancer patients with liver metastases who received radioembolization treatment were assessed. Treatment response was assessed using imaging modalities, including PET-CT, MRI, and CT. PET-CT was predominantly used to assess treatment response. The primary endpoints were overall survival (OS) and treatment response, while secondary outcomes included toxicity profiles and prognostic factors influencing survival. The cohort's median OS was 9 months, with a mean OS of 13.2 months. Patients exhibiting metabolic response on PET-CT had significantly longer survival (19.3 months) compared to non-responders (8.3 months, p = 0.042). Extrahepatic disease was a strong prognostic factor, with patients with extrahepatic involvement showing a significantly lower OS (7.1 vs. 21 months, p = 0.000). Bilobar disease, observed in 47 patients, was also associated with reduced survival (p = 0.003). Nearly all patients experienced mild to moderate side effects, with the most common being abdominal pain, nausea, and vomiting. Severe toxicities were rare, although one patient developed a gastric ulcer. Y-90 radioembolization is an effective and relatively safe treatment for unresectable CLM, particularly in patients without extrahepatic disease. The strong association between metabolic response and survival underscores the potential of PET-CT as a prognostic indicator. Further prospective studies are needed to refine patient selection criteria and optimize treatment protocols.©2025 NTMS.

Keywords: Colorectal Cancer; Radioembolization; Liver Metastases.

1. Introduction

Colorectal cancer (CRC) is among the most common cancer worldwide. A significant proportion of CRC patients develop liver metastases (colorectal liver metastases, CLM), which critically impact prognosis

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and treatment strategies[1]. While surgical resection remains the gold standard for CLM management, only few (20–30%) of patients are eligible for surgery[2]. Consequently, there is a growing need for alternative, effective locoregional therapies to manage unresectable liver metastases.

Radioembolization has come out as a promising treatment modality for patients with unresectable CLM. This technique involves the intra-arterial administration of yttrium-90 (Y-90) microspheres, which deliver targeted radiation to tumor cells while sparing healthy liver tissue[3]. Radioembolization has been utilized as a salvage therapy for chemotherapy refractory CLM and as a bridge to resection or transplantation in select cases[4]. Despite its increasing application, the effectiveness of radioembolization in improving survival and tumor control remains an area of active investigation.

Numerous studies have investigated the effects of radioembolization on survival in patients with colorectal cancer who have liver metastases. Retrospective and prospective analyses suggest that radioembolization can lead to meaningful tumor regression and prolonged survival, particularly in patients who have exhausted standard systemic treatment options[5]. Additionally, the combination of radioembolization with systemic chemotherapy has shown promise in enhancing tumor response rates[6].

This study aims to evaluate the effectiveness of radioembolization in the treatment of colorectal cancer liver metastases by analyzing clinical outcomes, imaging-based response assessments, and patient survival metrics. Understanding the therapeutic potential and limitations of radioembolization will help refine treatment algorithms and improve patient selection criteria for this intervention.

2. Material and Methods

2.1. Patient Information

The study included a total of 59 patients diagnosed with colorectal cancer and liver metastases, comprising 37 males and 22 females. This was a retrospective study, and approval was obtained from the university's ethics committee.

Before treatment, all patients were evaluated for hepatic reserve, bone marrow reserve, renal function, and hepatic vascularization. Patients with hepatic failure signs, including extensive ascites, portal hypertension, or portal vein thrombosis, were excluded. As part of routine clinical practice, all patients were evaluated by the departments of Medical Oncology, General Surgery, Gastroenterology, and Radiology, and they were deemed unsuitable for surgery before the radioembolization (RE) procedure. Hepatic/celiac angiography was performed on all patients to assess hepatic arterial anatomy and plan therapy. During this procedure, coil embolization of the gastroduodenal artery was performed to prevent gastrointestinal reflux. Additionally, hepatic arterial perfusion scintigraphy was conducted to evaluate potential shunting to the lungs and gastrointestinal tract.

Patients with a hepatopulmonary shunt greater than 20% were excluded from the study to prevent pulmonary radiation fibrosis. For eligible patients, the therapeutic dose of Y-90 microspheres was calculated using the body surface area method.

Resin microspheres were injected intra-arterially into the hepatic artery under fluoroscopic guidance. To verify microsphere retention within liver lesions and the absence of extrahepatic leakage, whole-body planar images were obtained using a gamma camera at 2–6 hours post-administration. All patients were admitted for overnight observation to monitor for postembolization syndrome, and symptomatic treatment (NSAIDs, antiemetics, and H2 receptor antagonists) was administered.

2.2. Follow-Up

To assess liver metastases, including tumor location, size, and number, pre-treatment imaging studies such as CT, MRI, and PET scans were reviewed. Many of the patients underwent PET-CT evaluation both before treatment and at six weeks post-treatment. Although post-treatment CT scans were recommended for all patients, they were often unavailable due to many patients traveling from other cities and being in terminal stages of the disease.

2.3. Treatment Response

Treatment response was evaluated using visual and semi-quantitative assessments of metabolic activity in 18F-FDG PET-CT scans performed before and after treatment. A decrease in tumor size and metabolic activity was classified as a “response to treatment,” whereas stable or increased metabolic activity, or the appearance of new lesions, was classified as “no response to treatment.”

2.4. Statistical Analysis

SPSS version 20.0.0 was used for statistical analysis. The Kaplan-Meier method was used to analyze mean and median cumulative survival. Survival times were compared using the log-rank (Mantel-Cox) test, with a p-value of less than 0.05 considered statistically significant.

3. Results

Between June 2008 and October 2013, a total of 70 radioembolization treatments were administered to 59 patients. As survival data for 2 patients were unavailable, they were excluded from the analysis. The mean age of the patients was 60 ± 10.4 years (range: 32-85). Among them, 36 were male and 21 were female. The primary tumor was in the colon in 47 patients and in the rectum in 10 patients. Pre-treatment CT, MRI, and PET-CT imaging revealed extrahepatic involvement in 27 patients. Bilobar disease was present in 47 patients. All patients had previously received systemic chemotherapy. Before treatment, 9 patients

had undergone radiofrequency ablation, 1 patient had received alcohol injection, 3 patients had undergone surgical resection, and 1 patient had undergone chemoembolization for liver metastases.

3.1. Radioembolization

Microsphere treatment was administered to a single liver lobe in 37 patients (29 right, 8 left) and to both lobes in 22 patients. Eleven patients underwent a second session of radioembolization. The average administered dose was 1.59 GBq. Pre-treatment median values were AST: 32 U/L, ALT: 24 U/L, and bilirubin: 0.7mg/dL.

3.2. Toxicity

Almost all patients experienced various degrees of treatment-related side effects. Two patients died on days 5 and 12 post-treatment, and they were excluded from the study. One patient was diagnosed with a gastric ulcer via endoscopy. Other patients experienced abdominal pain, loss of appetite, nausea, and vomiting, but these side effects lasted less than one month.

3.3. Treatment Response and Survival

To assess treatment response, 28 patients underwent 18F-FDG PET-CT imaging before and 6 weeks after treatment. Additionally, pre- and post-treatment abdominopelvic CT scans were available for 2 patients, and abdominal MRI scan were available for 1 patient.

The overall survival (OS) duration for all patients was found to be an average of 13.2 months, with a median survival time of 9 months. Out of 57 patients, 49 (86%) had passed away, while 8 patients (14%) were still alive during the follow-up period.

Among the 28 patients who were evaluated using 18F-FDG PET-CT, 25 showed a response to treatment, while 3 did not. During follow-up, 22 of these 28 patients died. The treatment-responsive group had a mean survival time of 19.3 months, while the non-responsive group had a mean survival of 8.3 months. The overall mean survival was 18.1 months, with a statistically significant difference between the groups ($p = 0.042$) (Figure 1).

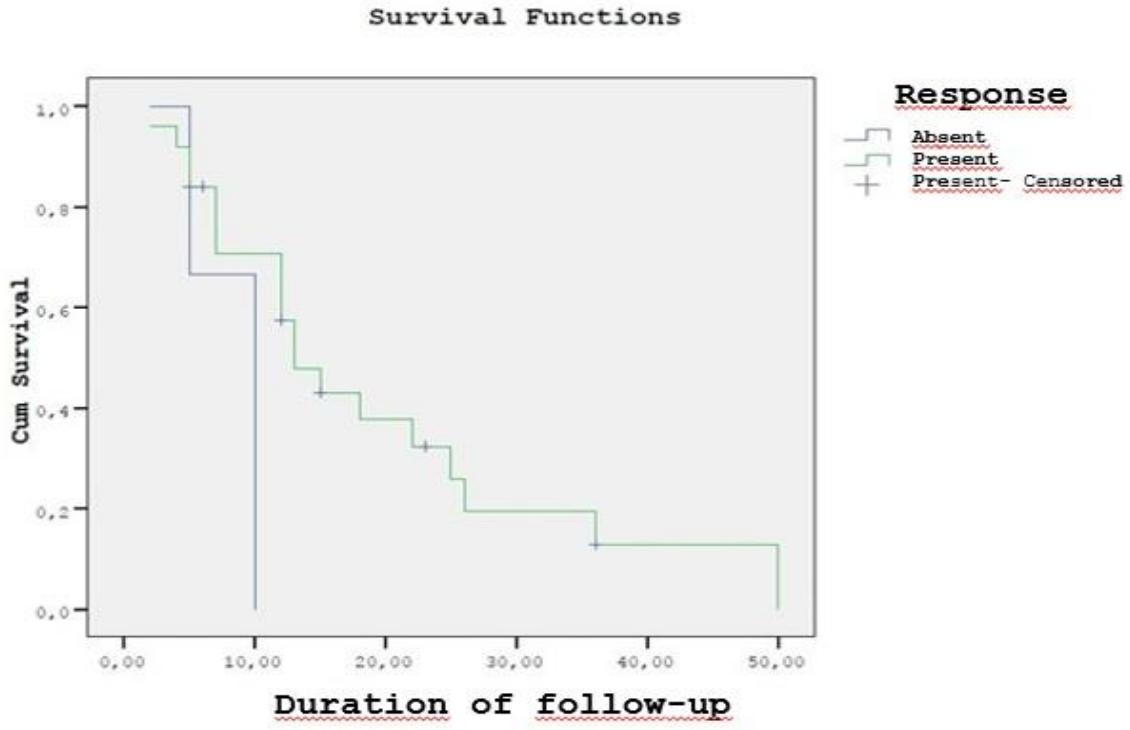

Figure 1: A significant difference was found in survival durations between the groups that responded and did not respond to treatment on FDG-PET CT.

For the three patients evaluated using CT and MRI, one showed partial response (PR), one had stable disease (SD), and one had progressive disease (PD). Due to the small number of patients in this group, statistical evaluation was not possible.

The primary tumor was located in the colon in 47 patients and in the rectum in 10 patients. The mean survival time for patients with a colonic primary tumor was 11.4 months, while for those with a rectal primary tumor, it was 22.8 ± 7.1 months. The difference between the two groups was not statistically significant ($p = 0.125$).

Among the 57 patients, 40 were younger than 65 years, and 17 were older than 65 years. The difference in survival between these two age groups was not statistically significant (p = 0.921). Similarly, there was no statistically significant difference in survival between male and female patients (p = 0.693).

Pre-treatment CT, MRI, and PET-CT evaluations revealed extrahepatic involvement in 26 patients. The mean survival time for patients without extrahepatic involvement was 21 ± 3.3 months, whereas for those with extrahepatic involvement, it was 7.1 ± 0.8 months. This difference was found to be statistically significant (p = 0.000) (Figure 2).

Bilobar disease was present in 45 patients, the other 12 patients had unilobar diease. The difference between the two groups was found to be statistically significant (p = 0.003) (Figure 3).

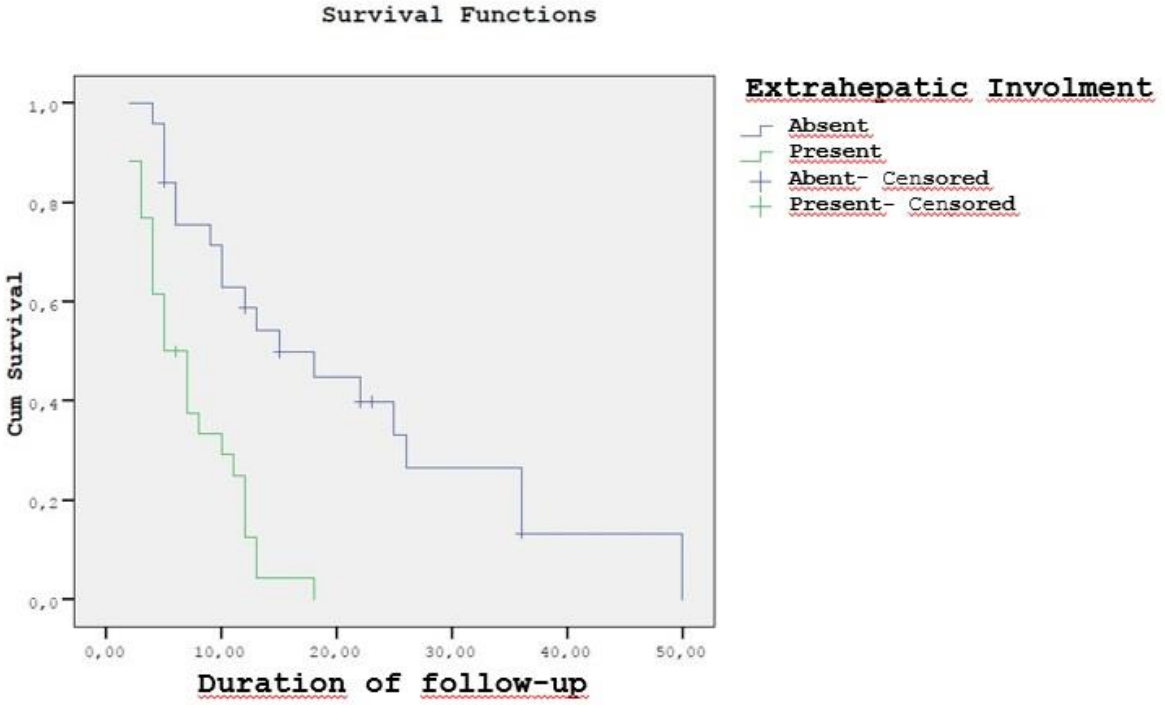

Figure 2: A significant difference was found in survival durations between the groups with and without extrahepatic involvement.

4. Discussion

Colorectal cancer ranks among the most prevalent malignancies globally, with liver metastases developing in approximately 50% of patients throughout the progression of the disease[7]. Treatment options for CRLM include surgery, systemic chemotherapy, targeted therapy, and locoregional treatments such as radioembolization[8]. In this study, we evaluated the effectiveness of Y-90 RE in patients with CRLM, assessing treatment response, toxicity, and OS. Our findings indicate that RE is a viable treatment option for CRLM patients who are not candidates for surgical resection. The median OS in our study was 9 months, with patients who responded to treatment exhibiting a significantly longer survival compared to non-responders (19.3 vs. 8.3 months, p=0.042). These results align with previous studies that have reported median OS ranging from 8 to 20 months following RE for CRLM[9,10]. The significant survival difference between responders and non-responders suggests that early metabolic response, evaluated through 18F-FDG PET-CT, could be a valuable prognostic marker for treatment effectiveness.

The presence of extrahepatic disease significantly influenced survival in our cohort, with patients without extrahepatic spread demonstrating a mean OS of 21 months, compared to 7.1 months in those with extrahepatic involvement (p = 0.000). This finding is consistent with prior reports that have suggested that extrahepatic disease burden is a major determinant of survival following RE[11]. In contrast, age, sex, and primary tumor location (colon vs. rectum) did not significantly impact OS, which is also in agreement with prior studies indicating that tumor biology and burden may be more relevant prognostic factors than demographic variables[12].

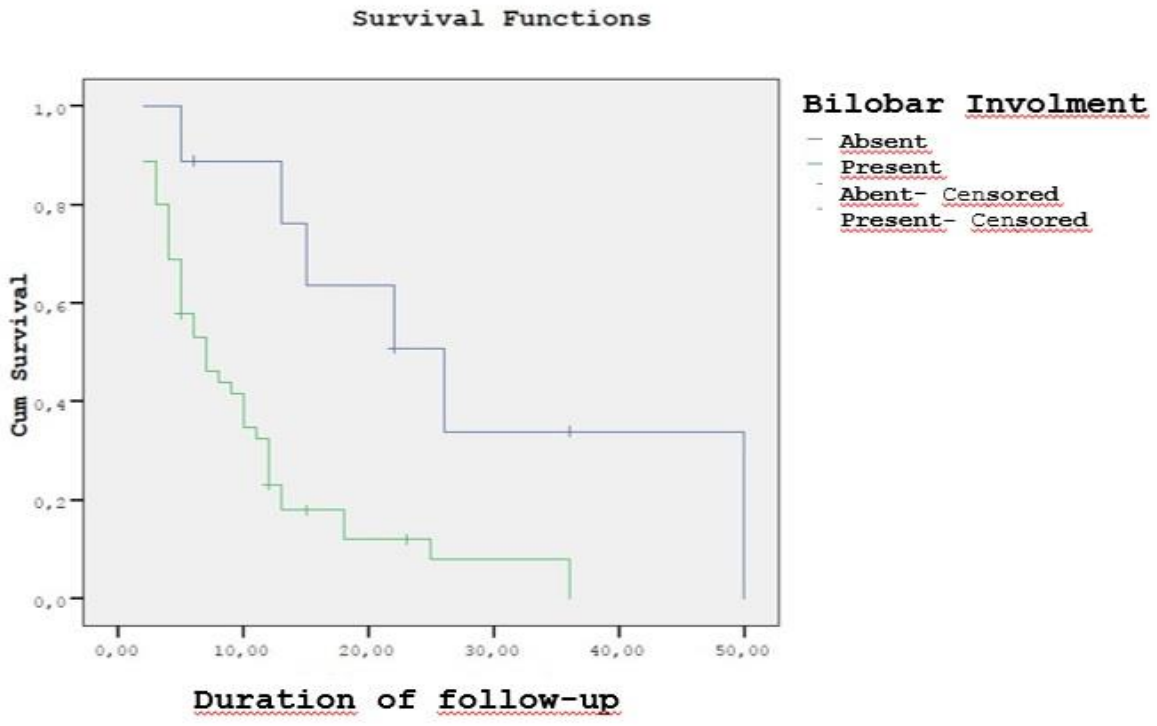

Figure 3: A significant difference was found in survival durations between the groups with and without bilobar involvement.

A key concern regarding RE is treatment-related toxicity. In our study, nearly all patients experienced some degree of side effects, with the most common being abdominal pain, nausea, and vomiting, consistent with post-radioembolization syndrome[10]. One patient developed a gastric ulcer, which highlights the importance of meticulous angiographic planning to avoid non-target radiation. Importantly, the incidence of severe toxicities was low, supporting the relative safety of RE when performed with appropriate patient selection and dosimetry considerations[13].

A notable limitation of our study is its retrospective design, which may introduce selection bias. Additionally, the lack of post-treatment imaging for some patients, primarily due to follow-up difficulties in terminal-stage cases, limits our ability to fully assess long-term outcomes. Future prospective studies with standardized imaging follow-up and larger patient cohorts are needed to further validate these findings.

5. Conclusion

In conclusion, our study suggests that Y-90 radioembolization is an effective and relatively safe treatment for CRLM, particularly in patients without extrahepatic disease. The significant association between metabolic response and survival highlights the potential role of 18F-FDG PET-CT as a prognostic tool in treatment planning. As systemic therapies continue to evolve, integrating RE into multimodal treatment strategies may further improve outcomes in this challenging patient population.

Limitations of the Study

The retrospective design and the lack of post-treatment imaging for some patients are among our study limitations.

Acknowledgement

None.

Conflict of Interests

There are no conflicts of interest reported by the authors.

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Author Contributions

Concept – DK, AP, US; Design - DK, AP, US; Supervision – OK, SB, US; Resources - AP, CS; Materials - AP, CS; Data Collection and/or Processing - DK, AP, CS, US; Analysis and/or Interpretation – DK; Literature Review - DK, AP, CS; Writing - DK, ZO, US; Critical Review – AP, US.

Ethical Approval

The Institutional Review Board of Ankara University Faculty of Medicine approved this retrospective study protocol (approval no: 04-131-14, date: 10.03.2014).

Data sharing statement

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Consent to participate

None.

Informed Statement

None.

References

1. Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer statistics. *CA Cancer J Clin.* 2023; 73(1):17-48.
2. Van Cutsem E, Cervantes A, Adam R, et al. ESMO consensus guidelines for the management of patients with metastatic colorectal cancer. *Ann Oncol.* 2022; 33(7):664-84.
3. Salem R, Thurston KG, Carr BI, et al. Yttrium-90 microspheres in the treatment of liver malignancies: Current status and future prospects. *Hepatology.* 2021; 74(4):2198-210.
4. Garin E, Tselikas L, Guiu B, et al. Radioembolization for colorectal liver metastases: Where do we stand? *J Hepatol.* 2020; 73(5):998-1010.
5. Ricke J, Wust P, Wieners G, et al. Efficacy and safety of radioembolization in colorectal cancer liver metastases: A systematic review. *Eur Radiol.* 2021; 31(6):3728-42.
6. Kennedy AS, Nutting C, Coldwell D, et al. Combination of radioembolization and systemic chemotherapy for colorectal liver metastases: Current evidence and future directions. *J Clin Oncol.* 2022; 40(12):1342-52.
7. Van Cutsem E, Cervantes A, Adam R, et al. ESMO consensus guidelines for the management of patients with metastatic colorectal cancer. *Ann Oncol.* 2016; 27(8):1386-422.
8. Salem R, Thurston KG. Radioembolization with 90Y microspheres: A state-of-the-art brachytherapy treatment for primary and secondary liver malignancies. *J Vasc Interv Radiol.* 2010; 21(8):1153-73.
9. Kennedy AS, McNeillie P, Dezarn WA, et al. Treatment parameters and outcome in 680 treatments of internal radiation with resin 90Y-microspheres for unresectable hepatic tumors. *Int J Radiat Oncol Biol Phys.* 2015; 91(2):298-307.
10. Sangro B, Martinez-Urbistondo D, Bester L, et al. Radioembolization in patients with intrahepatic cholangiocarcinoma: A systematic review. *J Hepatol.* 2011; 55(5):1083-91.
11. Riaz A, Lewandowski RJ, Kulik L, et al. Radiotherapy for unresectable intrahepatic cholangiocarcinoma: Review and comparison of techniques. *Hepatol Int.* 2014; 8(4):457-69.
12. Sharma RA, Wasan HS, Davidson BR, et al. Overall survival benefit in patients with colorectal liver metastases treated with selective internal radiation therapy using yttrium-90 resin microspheres: A randomized trial. *J Clin Oncol.* 2016; 34(15):1723-31.
13. Garin E, Rolland Y, Edeline J, et al. Personalized dosimetry with yttrium-90 resin microspheres in the treatment of liver metastases: Impact on clinical outcome and treatment planning. *J Nucl Med.* 2017; 58(8):1245-51.