Radiation Segmentectomy vs Lobectomy Techniques: Precision Approaches in Y-90 Therapy of Hepatocellular Carcinoma

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Purpose

- Explored the advances and comparative effectiveness of radiation segmentectomy and radiation lobectomy in Yttrium-90 (Y-90) transarterial radioembolization (TARE) for hepatocellular carcinoma (HCC)
- Focused on precision-based advances from 2010 to 2025.
- Key topics included clinical indications, dosimetric innovations, and outcomes influencing current treatment paradigms.

Materials & Methods

- A review of PubMed-indexed studies was conducted assessing segmental and lobar Y-90 TARE therapies.
- Emphasis was placed on data related to local tumor control, future liver remnant (FLR) hypertrophy, overall survival (OS), progression-free survival (PFS), resectability, toxicity, and personalized dosimetry.
- Foundational studies included the LEGACY study,[1] the DOSISPHERE-01 trial,[2] and multicenter analyses comparing segmentectomy and lobectomy approaches.

Results

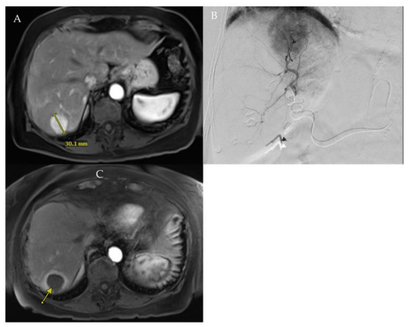

Figure 1: (A). Baseline MRI hyper-enhanced 3 cm tumor in segment 7. (B). Angiography of segment 7 branch of posterior right hepatic artery confirmed tumor perfusion. (C). Patient underwent RADSEG, with 1-month follow-up showing complete response of treated tumor (arrow).

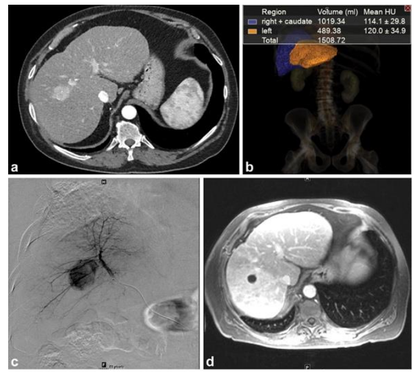

Figure 2: (a) Baseline triphasic CT scan of a 66-year-old patient with hepatitis C cirrhosis and unresectable HCC in the right lobe. (b) Volumetric assessment shows a baseline FLR of 32%. (c) The patient underwent radiation lobectomy in the right lobe. (d) MRI follow-up at 2 months post-Y90 demonstrates complete tumor response by mRECIST criteria.

- Radiation segmentectomy, which delivers ablative doses (>190–400 Gray [Gy]) to one or two hepatic segments, has demonstrated high complete response (CR) rates (>90%) and low toxicity in early-stage HCC.[3]
- The LEGACY study reported an 88% objective response rate and a median OS of 44.6 months.[1] The DOSISPHERE-01 trial showed that personalized high-dose segmental therapy more than doubled median OS compared to standard dosimetry (26.6 vs. 10.7 months).[2] The RASER trial reported 90% sustained CR with segmental doses exceeding 1,000 Gy and minimal adverse events.[4]
- Radiation lobectomy promotes substantial FLR hypertrophy (24–47%) while maintaining tumor control.[5] Compared to portal vein embolization (PVE), it provides greater hypertrophy (63% vs. 36%) and improved oncologic outcomes, although resection rates may be slightly lower.[6]

Conclusions

- Radiation segmentectomy and lobectomy are precision-based strategies for treating HCC.
- Segmentectomy offers a minimally invasive, curative-intent approach for early-stage disease, while lobectomy serves as a downstaging tool to increase resectability in advanced cases.
- The integration of advanced imaging, personalized dosimetry, and microcatheter-based delivery has improved outcomes and safety. Ongoing prospective studies are essential to further refine patient selection and standardize treatment protocols.

References

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