Publications on the Clinical Use of SIR-Spheres® Y-90 resin microspheres

Since the first experimental patients were treated in the late 1980s, numerous reports detailing the use of SIR-Spheres Y-90 resin microspheres have appeared in the literature. These papers have been from a variety of clinical study and routine experience settings and are presented here as a bibliography in different tumour types and in chronological order (latest first). In addition, the interim results of other studies that have as yet only been presented at scientific meetings are provided separately in each tumour type.

Review articles, technical papers and books or chapters on selective internal radiation therapy (SIRT) or radioembolisation that are useful sources of information on areas related to treating patients with SIR-Spheres Y-90 resin microspheres are also listed, again in chronological order in each section.

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Colorectal Cancer Liver Metastases

Prospective Clinical Studies in Colorectal Cancer Liver Metastases


Dutton SJ, Kenealy N, Love SB et al. FOXFIRE protocol: an open-label, randomised, phase III trial of 5-fluorouracil, oxaliplatin and folinic acid (OxMdG) with or without Interventional Selective Internal Radiation Therapy (SIRT) as first-line treatment for patients with unresectable liver-only or liver-dominant metastatic colorectal cancer. BMC Cancer 2014; 14: 497.


Mancini R, Carpanese L, Sciuto R et al. A multicentric phase II clinical trial on intra-arterial hepatic radiotherapy with 90Yttrium SIR-Spheres in unresectable, colorectal liver metastases refractory to i.v. chemotherapy: Preliminary results on toxicity and response rates. *In vivo* 2006; 20: 711–714.


**Abstracts on Prospective Clinical Studies in Colorectal Cancer Liver Metastases**


Rose SC, Roeland E, Shimabukuro K et al. Single center prospective phase II trial of yttrium-90 radioembolization for colorectal liver metastases that have failed first line chemotherapy and prior to initiation of second line chemotherapy: study design and early results. *Cardiovascular and Interventional Radiology in Europe (CIRSE) 2011; Abs. 1306.4.


**Retrospective Studies in Colorectal Cancer Liver Metastases**


Chua TC, Bester L, Akther J, Morris DL. Successful right hepatectomy after four treatments of yttrium-90 microspheres (SIR-Spheres(R)) and concomitant FOLFOX as bridging therapy to resection of colorectal liver metastases. *Anticancer Research* 2010; 30: 3005–3007.


**Abstracts on Retrospective Studies in Colorectal Cancer Liver Metastases**


Kennedy AS, Ball D, Cohen SK et al. Safety and efficacy of 90Y resin microspheres in elderly (>70 years) compared to younger patients with colorectal liver metastases (mCRC). ASCO Annual Meeting, Journal of Clinical Oncology 2013; 31 (Suppl): Abs. e14545.


Schoen M, Kant D, Dietrich J et al. Selective internal radiation therapy (SIRT) prior to liver resection for colorectal liver metastases. *International Hepato-Pancreato-Biliary Association Congress* 2012; C443.

Coldwell D, Schacht M, Sharma V. Differential response to radioembolization for colorectal cancer metastases to the liver in KRAS mutant patients. *World Conference on Interventional Oncology (WCIO) meeting* 2012; Abs. 48.

Leoni C, Mosconi C, Giampalma E et al. Response and survival after \(^{90}\text{Y}\) radioembolisation of colorectal liver metastases refractory to chemotherapy. *European Society of Radiology ECR* 2012; Abs. C-0735.


Grabowski SF, Nichols EM, Kudryasheva S et al. The efficacy of selective internal radiation therapy (SIRT) with yttrium-90 (Y90) is enhanced when given in low volume disease and in conjunction with other liver-directed therapies. *53rd Annual Meeting of American Society for Radiation Oncology (ASTRO), International Journal of Radiation Oncology, Biology and Physics* 2011; 81 (2 Suppl): S353–S354 Abs. 2296.


Paprottka PM, Hoffmann RT, Trumm CG et al. \(^{90}\text{Y}\)yttrium-radioembolization of chemotherapy-refractory colorectal cancer liver metastases. *World Conference on Interventional Oncology (WCIO) meeting* 2011; Abs. 52.


Cucci AR, Martin EW Jr., Bloomston M et al. \(^{90}\text{Y}\) radioembolization in the treatment of colorectal cancer that is metastatic to the liver. *ASCO Gastrointestinal Cancers Symposium, Journal of Clinical Oncology* 2011; 29 (Suppl 4): Abs. 593.

Ju AW, Hamidi M, Bradley KA et al. The use of bevacizumab prior to radioembolization of colorectal liver metastases with yttrium-90 resin microspheres. *52nd Annual Meeting of American Society for


Sangro B, Chopitea A, Rodriguez J et al. Radioembolization using Y90-labeled resin microspheres (Y90-RE) as consolidation treatment after 1st-line chemotherapy (CtT) for liver metastases from colorectal cancer (CRC). *ASCO Gastrointestinal Cancers Symposium* 2010; Abs. 250.


Kennedy A. Long-lived complete responders following radioembolization: Does this challenge the orthodox belief of disease progression? *2nd European Symposium on Liver-Directed Cancer Therapies using Microspheres* February 2008.


Rivet M. Monitoring 90Y-SIR-Sphere treatment response with 18FDG-PET. *36th Annual Scientific Meeting of the Australian and New Zealand Society of Nuclear Medicine* April 2006; Abs. 14.


Hepatocellular Carcinoma

Prospective Clinical Studies in Hepatocellular Carcinoma


Abstracts on Prospective Clinical Studies in Hepatocellular Carcinoma


Chow PK, Poon D, Choo S et al. Phase I study of SIR-Sphere plus sorafenib as first-line treatment in patients with nonresectable hepatocellular carcinoma: The Asia-Pacific Hepatocellular Carcinoma

Retrospective Studies in Hepatocellular Carcinoma


Wigg A. Yttrium 90 therapy for HCC; is it any better than conventional external beam radiotherapy? *Hepatology* 2012; 55: 981.


Abstracts on Retrospective Studies in Hepatocellular Carcinoma


Rana N, Ju AW, Bazylewicz M et al. Yttrium-90 radioembolization is safe in patients with hepatocellular carcinoma who have received sorafenib. *15th Annual Symposium on Clinical Interventional Oncology (CIO) 2013; Abs. 11.


Fiore F, Bilbao JI, Carpanese L et al. The efficacy, safety, and tolerability of radioembolization in unresectable hepatocellular carcinoma with whole-liver, lobar, or segmental treatment. *World Conference on Interventional Oncology (WCIO) meeting 2012; Poster 18.


Sangro B, Carpanese L, Salvatori R et al. Safety and efficacy of radioembolization amongst patients who met the inclusion criteria for the Sorafenib Hepatocellular Carcinoma Assessment Randomized Protocol (SHARP) trial. 5th International Liver Cancer Association (ILCA) meeting September 2011; Abs. P-141.

Sangro B, Maini CL, Notarianni E et al. Radioembolization for unresectable hepatocellular carcinoma (HCC) in the elderly. 5th International Liver Cancer Association (ILCA) meeting September 2011; Abs. P-142.


Vennarecci G, Sciuto R, Carpanese L et al. Use of hepatic intra-arterial infusion of yttrium-90 microspheres as down-staging and bridge to liver transplantation in patients with hepatocellular carcinoma. 7th Meeting of the HCC Eastern & Western Experiences (HCC2011) 2011; Abs. 57.


Cabrera R, George T, Soldevila-Pico C et al. Safety of sorafenib alone or in combination with locoregional therapy in patients with advanced hepatocellular carcinoma (HCC) and decompensated cirrhosis. ASCO Gastrointestinal Cancers Symposium 2008; Abstract 147.
Neuroendocrine Tumour Liver Metastases

Prospective Clinical Studies in Neuroendocrine Tumours Liver Metastases


Abstracts on Prospective Clinical Studies in Neuroendocrine Tumour Liver Metastases


Retrospective Studies in Neuroendocrine Tumour Liver Metastases


Lacin S, Oz I, Ozkan E et al. Intra-arterial treatment with $^{90}$Yttrium microspheres in treatment-refractory and unresectable liver metastases of neuroendocrine tumors and the use of $^{111}$In-octreotide scintigraphy in the evaluation of treatment response. *Cancer Biotherapy & Radiopharmaceuticals* 2011; **26**: 631–637.


Cao CQ, Yan TD, Bester L et al. Radioembolization with yttrium microspheres for neuroendocrine tumour liver metastases. *British Journal of Surgery* 2010; **97**: 537–543.


Ho K. Malignant insulinomas with hepatic metastases successfully treated with selective internal radiation therapy. *Clinical Endocrinology (Oxford)* 2006; **65**: 410–411.


**Abstracts on Retrospective Studies in Neuroendocrine Tumour Liver Metastases**


McIntosh EB, Prajapati HJ, Lawal TO et al. Prognostic factors of resin-based Yttrium-90 radioembolization for unresectable metastatic neuroendocrine tumors. World Conference on Interventional Oncology (WCIO) meeting 2012; Abs. 49.


Kennedy A, Elkordy M, Campbell EE et al. $^{90}$Y radioembolization for neuroendocrine cancers liver metastases provides sustained therapeutic effect with minimal toxicity. ASCO Gastrointestinal Cancers Symposium 2012; Abs. 343.


Paprottka PM, Hoffmann RT, Trumm CG et al. $^{90}$Yttrium-radioembolization of symptomatic, nonresectable neuroendocrine hepatic metastases. World Conference on Interventional Oncology (WCIO) meeting 2011; Abs. 51.

Faust H, Metz D, Soulen MC. Y-90 radioembolization is effective initial and salvage therapy for metastatic neuroendocrine tumors. World Conference on Interventional Oncology (WCIO) meeting 2011; Abs. P13.


Breast Cancer Liver Metastases

Prospective Clinical Studies in Breast Cancer Liver Metastases

Retrospective Studies in Breast Cancer Liver Metastases

Abstracts on Retrospective Studies in Breast Cancer Liver Metastases
Pancreatic Cancer Liver Metastases

Prospective Clinical Studies in Pancreatic Cancer Liver Metastases

Abstracts on Prospective Studies in Pancreatic Cancer Liver Metastases

Retrospective Studies in Pancreatic Cancer Liver Metastases

Abstracts on Retrospective Studies in Pancreatic Cancer Liver Metastases
Cholangiocarcinoma

Prospective Clinical Studies in Cholangiocarcinoma


Abstracts on Prospective Studies in Cholangiocarcinoma


Retrospective Studies in Cholangiocarcinoma


Abstracts on Retrospective Studies in Cholangiocarcinoma


Melanoma Liver Metastases

Retrospective Studies in Melanoma Liver Metastases


Abstracts on Retrospective Studies in Melanoma Liver Metastases


Lung Cancer Liver Metastases

Retrospective Studies in Lung Cancer Liver Metastases

Cervical Cancer Liver Metastases

Retrospective Studies in Cervical Cancer Liver Metastases

Desmoplastic Small Round Cell Tumour Liver Metastases

Retrospective Studies in Desmoplastic Small Round Cell Tumour Liver Metastases

Renal Cell Carcinoma Liver Metastases

Retrospective Studies in Renal Cell Carcinoma Liver Metastases

Hemangioendothelioma Liver Metastases

Retrospective Studies in Hemangioendothelioma Liver Metastases


Testicular Cancer Liver Metastases

Retrospective Studies in Testicular Cancer Liver Metastases

Primary or Metastastic Soft Tissue Sarcomas of the Liver

Abstracts on Retrospective Studies in Primary or Metastastic Soft Tissue Sarcomas of the Liver
Thyroid Cancer Liver Metastases

Retrospective Studies in Thyroid Cancer Liver Metastases

Liver Metastases from Cancer of Unknown Primary

Retrospective Studies in Liver Metastases from Cancer of Unknown Primary

Liver Tumours from Various Cancer Sources

Prospective Clinical Studies in Liver Tumours from Various Cancer Sources


Retrospective Studies in Liver Tumours from Various Cancer Sources


Brock H; Günther RW; Haage P. Leberzirrhose als folge selektiver hepatischer radioembolisation mit 90Yttrium-mikrosphären. *Fortschritte auf dem Gebiet der Röntgenstrahlen und der bildgebenden Verfahren* 2006; 178: 538–549. [in German]


**Abstracts on Retrospective Studies in Liver Tumours from Various Cancer Sources**


Sharma A, Kolar B, Katz A et al. Y90 radioembolization: Comparison of effects on clinical performance status and liver toxicity in patients with HCC and hepatic metastases from other primary tumors - a single institutional experience. *World Conference on Interventional Oncology (WCIO) meeting* 2012; Poster 44.

Withrow RC, Pohl C. Treatment of Stage 4 gynecologic malignancies by hepatic radioembolization. *World Conference on Interventional Oncology (WCIO) meeting* 2012; Poster 45.


Saxena A, Chua TC, Meteling B et al. Radioembolization with yttrium-90 microspheres is associated with a significantly improved survival compared to conservative therapy after treatment of unresectable hepatic tumors: A large single center experience of 537 patients. *65th Annual Cancer Symposium of the Society of Surgical Oncology, Asia-Pacific Journal of Clinical Oncology* 2012; 7 (Suppl S4): Abs. 212.

Fernández-Ros NF, Silva N, Iharrairaegui M et al. La radioembolización hepática lobar induce hipertrofia del lóbulo contralateral. *Spanish Association for the Study of the Liver 2012; Abs.*


Ruehl R, Seidensticker M, Denecke T et al. Selektive interne radioembolisation (SIRT) mit mikrophären bei extensiven, therapieresistierenden leberränten. *Deutsche Gesellschaft für Nuklearmedizin (DGN) 2008; Abs. [in German]


Nutting C, Jones B. Techniques for minimizing complications during yttrium-90 radioembolization of unresectable hepatic malignancies. *Cardiovascular and Interventional Radiology* 2004; 27 (Sup.1): Abs. 9.4.3.
SIR-Spheres microspheres are approved in Australia, the European Union (CE Mark) and several other countries for the treatment of patients with non-operable liver tumours. The papers and abstracts on this page report pre-clinical and clinical experience using SIR-Spheres microspheres in the treatment of malignancy outside of the liver, which are currently investigational in nature and that have not been approved or cleared by regulatory authorities.

Lung Malignancies

Retrospective Studies in Lung Metastases

Haematological Malignancies

Retrospective Studies in Malignant Lymphomatous Splenomegaly

Primary Renal Cancer

Preclinical Studies in Primary Renal Cancer
Mackie S, de Silva S, Aslan P et al. Super selective radio embolization of the porcine kidney with 

Consensus Statements / Guidelines

Colorectal Cancer Guidelines


Hepatocellular Carcinoma Guidelines


Neuroendocrine Tumour Guidelines
SIR-Spheres Y-90 resin microspheres Bibliography: April 2015


Cholangiocarcinoma


General Consensus Statements / Guidelines


American College of Radiology (ACR), American Society for Therapeutic Radiology and Oncology (ASTRO), and the Society of Interventional Radiology (SIR). Practice guideline for radioembolization with microsphere brachytherapy device (RMBD) for treatment of liver malignancies. 2008; Res. 2: http://www.acr.org/SecondaryMainMenuCategories/quality_safety/guidelines/iv/RMBD.aspx


Review Articles

Colorectal Cancer


Raval M, Bande D, Pillai A et al. Yttrium-90 radioembolization of hepatic metastases from colorectal cancer. *Frontiers in Oncology* 2014; **4**: 120.


Damm R, Seidensticker R, Rické J, Seidensticker M. [Interventional radiological procedures in the therapy for colorectal liver metastases]. *Zentralblatt für Chirurgie* 2013; **138**: 76–83. [in German]


Alberts SR. Update on the optimal management of patients with colorectal liver metastases. *Critical Reviews in Oncology Hematology* 2012; 84: 59–70.


de Baere T, Deschamps F. Arterial therapies of colorectal cancer metastases to the liver. *Abdominal Imaging* 2011; 36: 661–670.


Morris D. Selective internal radiation therapy with $^{90}$Y-microspheres for colorectal liver metastases: cart before the horse or otherwise? *ANZ Journal of Surgery* 2006; 76: 675.


**Hepatocellular Carcinoma**


Kolligs FT, Hoffmann RT, op den Winkel M et al. Diagnose und multimodale therapie des hepatozellulären karzinoms [Diagnosis and multimodal therapy for hepatocellular carcinoma]. *Zeitschrift für Gastroentrologie* 2010; 48: 274–288. [in German]


Poon RT. Recent advances in management of hepatocellular carcinoma. *Hong Kong Medical Diary* 2010; 15: 18–22.


Antoch G, Mueller SP, Hamami M et al. [Selektive interne radiotherapie (SIRT) beim hepatozellulären karzinom] / Selective internal radiotherapy (SIRT) for hepatocellular carcinoma. *Fortschritte auf dem Gebiet der Röntgenstrahlen und der bildgebenden Verfahren* 2010; 182: 660–670. [in German]


**Neuroendocrine Tumours**


Yang TX, Chua TC, Morris DL. Radioembolization and chemoembolization for unresectable neuroendocrine liver metastases – A systematic review. *Surgical Oncology* 2012; **21**: 299–308.


Saxena A, Chua TC, Morris DL. Surgical management and emerging therapies to prolong survival in metastatic neuroendocrine cancer. *Annals of Surgical Oncology* 2011; **18**: S222–S223.


Nazario J, Gupta S. Transarterial liver-directed therapies of neuroendocrine hepatic metastases. *Seminars in Oncology* 2010; **37**: 118–126.
Arnold R, Kegel T. Aktuelle therapiestrategien gegen neuroendokrine tumoren. *InFo Onkologie* 2010 Feb 18; 3–8. [in German]


Auernhammer CJ. Aktuelle standards und perspektiven in diagnostik und therapie von neuroendokrinen tumoren des gastroenteropankreatischen systems. *Journal Onkologie* 2008; 04–08. [in German]


Breast Cancer


Cholangiocarcinoma


Ocular Melanoma

Stedman B. Evidence-based integration of selective internal radiation therapy into the management of ocular melanoma liver metastases. *Future Oncology* 2014; 10 (Suppl): 97–100.


**Desmoplastic Small Round Cell Tumours**


**Pancreatic Cancer**


**General**


Bargellini I. How does selective internal radiation therapy compare with and/or complement other liver-directed therapies. *Future Oncology* 2014; **10** (Suppl): 105–109.


Zurkiya O, Suvaranu Ganguli S. Beyond hepatocellular carcinoma and colorectal metastasis: The expanding applications of radioembolization. *Frontiers in Oncology* 2014; **4**: 150.


Schmidt F, Senninger N, Wolters HH, Mees ST. Fortschritt, limitationen und zukunft der onkologischen leberchirurgie [Advances, limitations and prospects of oncological liver surgery]. *Zentralblatt für Chirurgie* 2014; **139**: 203–211. [Article in German]


Mäenpää H, Tenhunen M. [Radionuclide therapy for cancer—what’s new?]. *Duodecim* 2012; **128**: 2209–2216. [in Finnish]


Carr BI. Regional hepatic therapy for cancer. Seminars in Oncology 2010; 37: 82.


Vogl TJ, Lee C, Zangos S *et al.* Aktueller standpunkt zur selektiven internen radiotherapie (SIRT) bei malignen lebertumoren. *Hessisches Ärzteblatt* 2009 Sept; 584–590. [in German]


Mechanistic Aspects of Treatment

Papers on Mechanistic Aspects of Treatment


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Kao YH. Dosimetric theory for tumor-to-lung shunt fraction calculation in yttrium-90 radioembolization of noncirrhotic livers. *Nuclear Medicine Communications* 2014; **35**: 331–332.


Großer OS, Amthauer H, Ricke J. General theory of predictive dosimetry for Yttrium-90 radioembolization to sites other than the liver: Reply. *Cardiovascular and Interventional Radiology* 2014; **37**: 1120–1121. [Reply to Kao YH. *Cardiovascular and Interventional Radiology* 2014; **37**: 1114–1117.]

Muylle K, Vanderlinden B. Reply to letter re: General theory of predictive dosimetry for yttrium-90 radioembolization to sites other than the liver. *Cardiovascular and Interventional Radiology* 2014; **37**: 1118–1119. [Comment on Kao YH. *Cardiovascular and Interventional Radiology* 2014; **37**: 1114–1117.]

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Dieudonné A, Gardin I, Reguiga M et al. Dosimétrie personnalisée en radiothérapie interne vectorisée: Exemple du traitement des carcinomes hépatocellulaires par microsphères marquées à l’yttrium 90. [Personalized dosimetry in targeted radionuclide therapy: Example in the treatment of...


Chiesa C, Maccario M, Romito R et al. Need, feasibility and convenience of dosimetric treatment planning in liver selective internal radiation therapy with 90Y microspheres: the experience of the


McWilliams JP, Kee ST, Loh CT *et al.* Prophylactic embolization of the cystic artery before radioembolization: feasibility, safety, and outcomes. *Cardiovascular and Interventional Radiology* 2011; **34**: 786–792.


Breedis C, Young G. The blood supply of neoplasms in the liver. *American Journal of Pathology* 1954; **30**: 969–977.

Abstracts on Mechanistic Aspects of Treatment


Terulla A, Bergesio F, Roberto E et al. Treatment planning experience in radioembolization of hepatocarcinoma with $^{90}$Y microspheres. *European Association of Nuclear Medicine (EANM) Annual Meeting, European Journal of Nuclear Medicine and Molecular Imaging* 2014; 41 (Suppl 2); Abs. PW044.


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Kennedy A, McNeillie P, Dezarn W et al. Development of a tissue-equivalent human liver phantom for 90Y-microsphere dosimetry studies and testing of other local ablation therapies. ASCO Gastrointestinal Cancers Symposium 2012; Abs. 244.


Dominguez I, Ifarrairaegui M, Rodriguez M et al. Tumor vascularity and response to radioembolization using Y90 resin microspheres. *4th International Liver Cancer Association (ILCA) meeting* September 2010; Abs. P-133.

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Lau GBH, Wang SC, Ho YY. Technical aspects in the work up for yttrium 90 SIR-Spheres radioembolotherapy in the treatment of hepatic tumours. World Conference on Interventional Oncology (WCIO) meeting 2006; Abst. 8185.

Hepatic Arterial Anatomy

Papers on Hepatic Arterial Anatomy

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Theysohn JM, Müller S, Schlaak JF et al. Selective internal radiotherapy (SIRT) of hepatic tumors: how to deal with the cystic artery. *Cardiovascular and Interventional Radiology* 2013; **36**: 1015–1022.


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**Papers on Reduction of Lung Shunting**


**Abstracts on Hepatic Arterial Anatomy**


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Imaging

Papers on Imaging


Flamen P. Optimizing the use of PET with selective internal radiation therapy. *Future Oncology* 2014; 10 (Suppl): 73–75.


Bennink RJ, Cieslak KP, van Delden OM et al. Monitoring of total and regional liver function after SIRT. *Frontiers in Oncology* 2014; 4: 152.


van den Hoven AF, van Leeuwen MS, Lam MG, van den Bosch MA. Hepatic arterial configuration in relation to the segmental anatomy of the liver; observations on MDCT and DSA relevant to radioembolization treatment. *Cardiovascular and Interventional Radiology* 2014 Mar 7; ePub: 10.1007/s00270-014-0869-2.


Zade AA, Rangarajan V, Purandare NC et al. 90Y microsphere therapy: Does 90Y PET/CT imaging obviate the need for 90Y Bremsstrahlung SPECT/CT imaging? *Nuclear Medicine Communications* 2013; 34: 1090–1096.

Mamawan MD, Ong SC, Senupe JM. Post-90Y radioembolization PET/CT scan with respiratory gating using time-of-flight reconstruction. *Journal of Nuclear Medicine Technology* 2013; 41: 42.


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Gartenschlaeger M, Maus S, Buchholz H et al. Investigation for extrahepatic shunt before SIRT by PET/CT with $^{68}$Ga-MAA. *Nuklearmedizin* 2011; **50**: N37–N38.


Becker C, Waggershauser T, Tiling R et al. C-arm computed tomography compared with positron emission tomography/computed tomography for treatment planning before radioembolization. *Cardiovascular and Interventional Radiology* 2011; **34**: 550–556.


Kim KW, Lee JM, Choi BI. Assessment of the treatment response of HCC. *Abdominal Imaging* 2011; **36**: 300–314.


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Abstracts on Imaging


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