CLINICAL STUDY

Yttrium-90 Radioembolization with Resin Microspheres without Routine Embolization of the Gastroduodenal Artery

Thomas J. Ward, MD, John D. Louie, MD, and Daniel Y. Sze, MD, PhD

ABSTRACT

Purpose: To evaluate safety of resin microsphere radioembolization (RE) without prophylactic embolization of the gastroduodenal artery (GDA).

Materials and Methods: Between July 2013 and April 2015, all patients undergoing RE with resin microspheres for liver-dominant metastatic disease were treated without routine embolization of the GDA. Selective embolization of distal hepaticoenteric vessels was performed if identified by digital subtraction angiography, cone-beam computed tomography, or technetium-99m macroaggregated albumin scintigraphy. Resin microspheres were administered using 5% dextrose flush distal to the origin of the GDA in lobar or segmental fashion, with judicious use of an antireflux microcatheter in recognized high-risk situations. Gastrointestinal toxicity was evaluated by the performing physician for at least 3 months.

Results: RE with resin microspheres was performed in 62 patients undergoing 69 treatments. During planning angiography, embolization of 0 or 1 vessel (median, 1; range, 0–4) was performed in 86% of patients, most commonly the right gastric and supraduodenal arteries. Prophylactic embolization of the GDA was performed in only 2 patients (3%). In 6 treatments (9%), adjunctive embolization was required immediately before RE, and an antireflux microcatheter was used in 14% of treatments. Clinical follow-up was available in 60 of 62 patients (median, 134 d; range, 15–582 d). No signs or symptoms of gastric or duodenal ulceration were observed.

Conclusions: RE using resin microspheres without embolization of the GDA can be performed safely.

ABBREVIATIONS

ARMC = antireflux microcatheter, DSA = digital subtraction angiography, GDA = gastroduodenal artery, RE = radioembolization, RGA = right gastric artery

Radioembolization (RE) with yttrium-90 microspheres is an established locoregional therapy for treatment of primary and metastatic hepatic malignancies (1–3). Two device platforms are available—resin microspheres (SIR-Spheres; Sirtex Medical Ltd, North Sydney, Australia) and glass microspheres (TheraSphere; BTG International, Ottawa, Ontario, Canada). Resin microspheres measure 25–60 μm in diameter with a specific activity of 50 Bq per sphere at the time of calibration. Glass microspheres measure 20–30 μm but start with a specific activity of 2,500 Bq per sphere at the time of calibration. As a result, a 3-GBq vial of resin

From the Division of Interventional Radiology, H-3646 Stanford University Medical Center, 300 Pasteur Drive, Stanford, CA 94305-5642. Received May 19, 2016; final revision received September 3, 2016; accepted September 5, 2016. **Address correspondence to** T.J.W.; E-mail: Thomasjward@gmail.com

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microspheres has many more particles than a 3-GBq vial of glass microspheres: 40 million to 80 million resin microspheres compared with 1.2 million glass microspheres (4). The embolic load of treatment is greater with resin microspheres, potentially increasing the risk for stasis during delivery. If reflux of radioembolic particles into more proximal hepaticoenteric collateral vessels, such as the gastroduodenal artery (GDA) or the right gastric artery (RGA), occurs, the patient may develop radiation-induced gastrointestinal ulceration (5).

Endovascular skeletonization of the common hepatic artery via coil embolization of hepaticoenteric collateral vessels has been routinely recommended to decrease the risk of ulceration (6,7). However, this technique introduces new risks. Coil migration, recanalization, or arterial dissection may occur, and procedural time and cost are increased (8). Furthermore, coil embolization during preparatory angiography has been associated with the development of new hepaticoenteric collateral vessels and the need for adjunctive embolization the day of treatment (9). Although such patients underwent adjunctive embolization, patients who developed new collateral vessels were still at increased risk for gastrointestinal complications (9). An alternative to embolization is administration through an antireflux microcatheter (10). However, not all patients are good anatomic candidates for the device. If the vessel from which treatment is to be administered is proximal to a hepaticoenteric collateral vessel, or the vessel diameter is too small or too large, or the vessel is too tortuous, per the manufacturer's instructions for use, treatment via an antireflux microcatheter (ARMC) is not appropriate. Furthermore, vessel injury or spasm may occur.

Reduced embolic load, distal delivery, and formation of collateral vessels after coil embolization have led several investigators to question the need for routine embolization of the GDA when the patient is treated with glass microspheres (4). The higher embolic load of resin microspheres is believed to increase the risk of reflux and nontarget RE. The hypothesis of this article is that using current microsphere delivery methods, routine prophylactic embolization of the GDA is not required even with resin microspheres. The technique and initial experience with RE with resin microspheres without routine embolization of the GDA and with selective use of an ARMC are presented.

MATERIALS AND METHODS

Patients

Institutional review board approval was obtained for this retrospective study. All data were handled in compliance with the Health Insurance Portability and Accountability Act. Between July 2013 and April 2015, 127 consecutive patients with a primary or metastatic hepatic malignancy were treated with RE; 62 consecutive patients were treated with resin microspheres (SIR-Spheres). For consistency and regulatory compliance, patients with hepatocellular carcinoma were treated with glass microspheres, and patients with cholangiocarcinoma or metastatic liver disease were treated with resin microspheres. Patients were considered eligible if disease was liver-dominant, liver function was preserved (total bilirubin $\leq$ 2.0 mg/dL obtained a maximum of 72 hours before treatment), and Eastern Cooperative Oncology Group performance status was $\geq$ 2. Patient demographics are presented in **Table 1**.

Preparatory Angiography

Before RE, all patients underwent complete hepatic angiography to plan treatment, perform embolization of high-risk hepaticoenteric anastomotic vessels, and administer technetium-99m macroaggregated albumin (Jubilant DraxImage, Kirkland, Quebec, Canada) for hepatopulmonary shunt fraction measurement. A ceiling-mounted C-arm system (AXIOM Artis dTA; Siemens, Erlangen, Germany) was used for digital subtraction angiography (DSA) and cone-beam computed tomography (CT). Multiplanar reconstructions were generated on a workstation (syngo X; Siemens) to identify extrahepatic enhancement. DSA and volume-rendered cone-beam CT images were reviewed to identify the hepatic vessels that perfused the parenchyma affected by neoplastic disease as well as individual hepaticoenteric anastomotic vessels.

When the origin of hepaticoenteric anastomotic vessels was found to be near or distal to planned sites of

Table 1. Patient Demographics

	Mean or Percent	SD or Number
Age (y)	62	11
Male/female	38/62%	23/39
Diagnosis		
mNET	30%	18
mCRC	19%	12
CCA	19%	12
mBreast	10%	6
mRCC	3%	2
mSCUP	3%	2
mOvarian	3%	2
mGA or mGIST	3%	2
Other*	10%	6

CCA = cholangiocarcinoma; mBreast = metastatic breast cancer; mCRC = metastatic colorectal cancer; mGA = metastatic gastric adenocarcinoma; mGIST = metastatic gastrointestinal stromal tumor; mNET = metastatic neuroendocrine tumor; mOvarian = metastatic ovarian cancer; mRCC = metastatic renal cell carcinoma; mSCUP = metastatic squamous cell carcinoma, unknown primary.

*Other: 1 each of prostate, pancreatic adenocarcinoma, leiomyosarcoma, cholangiohepatoma, cutaneous melanoma, hepatocellular carcinoma (at time when glass microspheres were unavailable for a desired treatment date).