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## Interventional Radiology

# Approaches for safe transarterial chemoembolization of multifocal hepatocellular carcinoma with retrograde flow in a retroportal artery

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## ARTICLE INFO

## Article history:

Received 23 June 2017

Received in revised form 28 October 2017

Accepted 30 October 2017

Available online

## Keywords:

Surefire infusion system

Retroportal artery

Chemoembolization

Radioembolization

Hepatocellular carcinoma

## ABSTRACT

We report a case of an 81-year-old woman with multifocal hepatocellular carcinoma who underwent transarterial chemoembolization. The patient had significant superior mesenteric artery (SMA) ostial stenosis, which led to retrograde flow in the retroportal artery to the SMA. The authors adopted several approaches to avoid potential nontarget embolization that might result from the change in the hemodynamics in the hepatoenteric arteries by initially stenting the SMA ostial stenosis as well as the use of the Surefire infusion system and balloon occlusion for delivery of chemoembolization material to tumors in the hepatic lobes. To our knowledge, the collective use of these approaches to avoid potential risks related to SMA ostial stenosis and retrograde flow in a retroportal artery has not been previously described in the literature.

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## Introduction

Variations of the classic anatomy of hepatic arterial supply are rather common, occurring in 55% of patients in a study of 200 cadavers [1]. Hiatt et al [2] reported their own results of 1000 surgical patients and reviewed other series to conclude that

the classic anatomy occurs between 53% and 75% of cases depending on the modality used. Additional hepatic arterial supply has been reported to arise from the superior mesenteric artery (SMA), left gastric artery, aorta, and other visceral arteries. The hepatic lobes can receive partial or complete arterial supply from these anomalous arteries, termed completely or partially replaced (accessory) hepatic arteries [2,3].

Competing Interests: Souheil Saddekni is a consultant at Abbott Medical. Amr Soliman Moustafa, Sherif Moawad, Khalid Mahmoud, and Basant Farouk Hamed have nothing to disclose. Ahmed Kamel Abdel-Aal is a consultant at Abbott Medical, Bard Peripheral Vascular, Baxter Healthcare, Boston Scientific, and W.L. Gore.

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<https://doi.org/10.1016/j.radcr.2017.10.019>

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Transarterial chemoembolization (TACE) and radioembolization have taken a prominent place in the treatment of hepatic malignancy. These procedures require predictable, antegrade arterial blood flow to the malignant tissue because of the cytotoxic and occlusive materials used. Therefore, care must be taken to avoid inadvertent embolization of nontarget organs [4,5].

In certain cases, collateral flow from the celiac artery to the SMA and vice versa occurs because of significant stenotic or occlusive disease in the proximal SMA or celiac arteries. The anastomotic hepatoenteric collaterals are usually the main point of concern in these cases. Hepatofugal blood flow in these collaterals imposes a clinical challenge to targeted hepatic therapy. They are usually represented by the gastroduodenal artery and right gastric artery. However, special attention should also be taken to recognize an uncommon variant that may lead to treatment failure and potential nontarget embolization such as the less recognized retroportal artery [4,5].

The retroportal artery is a tiny branch of the SMA. This artery usually supplies the common bile duct and is not routinely seen on arteriography unless it is providing collateral blood supply to the liver [6]. It could be difficult to differentiate retroportal artery from a partially replaced right hepatic artery as both have a retroportal course. However, the retroportal artery anastomoses with the right hepatic artery without supplying any hepatic segment. Unlike the retroportal artery, the partially replaced right hepatic artery does not anastomose with the main hepatic artery but instead it directly supplies segments of the right hepatic lobe [7].

We present a case of a patient undergoing TACE with the retroportal artery arising from the SMA. The artery displayed retrograde filling because of severe ostial stenosis of the SMA. We describe certain approaches that can be employed, including the use of balloon occlusion technique and the Surefire infusion system (SIS) (Surefire Medical Inc., Westminster, CO), to avoid retrograde flow of embolization material into the SMA and possibly systemic circulation.

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## Case report

We present an 81-year-old woman who presented with recurrent multifocal hepatocellular carcinoma (HCC) in both hepatic lobes. A multidisciplinary consensus was to treat her recurrent tumors with TACE. The initial aortography showed retrograde filling of the SMA from the inferior mesenteric artery through a prominent arc of Riolan consistent with SMA stenosis, and through a connection between the right hepatic artery and SMA (Fig. 1A). Celiac arteriography demonstrated retrograde filling of the SMA from the hepatic artery through a prominent retroportal artery (Fig. 1B). Selective proper hepatic artery angiography demonstrated multiple tumor blushes in both hepatic lobes, consistent with multifocal HCC and retrograde flow in the retroportal artery filling the SMA (Fig. 1C). SMA angiography confirmed a severe ostial stenosis.

We decided to restore the antegrade flow in the retroportal artery to avoid reflux and nontarget embolization of the chemoembolization material through the retroportal artery into the SMA and systemic circulation when TACE is performed. We placed a 6 × 15 mm stent (Palmaz Blue; Cordis, Fremont, CA)

at the SMA ostial stenosis (Fig. 1D). Despite an apparently successful stenting, retrograde flow to the SMA through the retroportal artery continued.

We decided to prevent reflux of the chemotherapeutic material from the left hepatic artery into the SMA by injecting it through a balloon catheter. A 2 × 6 mm low-profile angioplasty balloon (Sprinter; Medtronic) was inflated in the proximal left hepatic artery, and the chemoembolization material (50 mg of doxorubicin loaded on 200-400 μm drug eluting beads [QuadraSphere; Merit, South Jordan, UT]) mixed with contrast agent was injected through the balloon catheter.

The patient was rescheduled after 8 weeks for TACE of the right hepatic lobe to allow time for restoring the antegrade flow from the SMA to the liver through the retroportal artery. Abdominal aortogram was performed and showed recoiled moderate stenosis at the ostium of the SMA (Fig. 2A). There was also persistent retrograde flow through the retroportal artery. We decided to use SIS as an alternative approach to avoid retrograde nontarget embolization of the chemoembolization material.

The SIS is a coaxial microcatheter system composed of a 3Fr infusion microcatheter with an expandable tip and a 4.8Fr guide sheath. The unique design of the SIS allows the expandable tip of the microcatheter to dynamically expand into the artery to prevent retrograde flow and avoid nontarget embolization, and collapses during antegrade flow thus allowing forward delivery of the chemoembolization material. The Surefire guide sheath was placed through the celiac trunk and into the right hepatic artery beyond the confluence of the right hepatic and retroportal arteries. The Surefire microcatheter expandable tip was then deployed, and the chemoembolic material was infused into the right hepatic artery as observed through fluoroscopy. There was no retrograde reflux during delivery of the chemoembolization material (Fig. 2B). The Surefire microcatheter was then removed and a follow-up arteriogram was performed through the Surefire microcatheter, showing no perceptible arterial flow to the hepatic tumors. There was persistent retrograde filling of the retroportal artery (Fig. 2B).

The patient displayed no signs of systemic embolization. Dynamic contrast-enhanced computed tomography scan of the abdomen was performed 4 weeks after the last session and the result showed partial response using the modified response evaluation criteria in solid tumors.

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## Discussion

Hepatic chemoembolization can be an effective and safe procedure if properly performed. Care must be taken to direct chemoembolization material to the tumor vascularity and avoid nontarget exposure of the gastrointestinal tract which might result in complications related to bowel ischemia and strictures. This case provides a challenge because of difficulty in delivering the chemoembolization material safely as a result of the retrograde flow in the retroportal artery. The first option chosen was to revert the retroportal artery to its normal antegrade flow. As the SMA stent placement was unsuccessful in restoring antegrade flow in the retroportal artery, another intervention was required to prevent inadvertent delivery of the chemoembolization material to the gastrointestinal tract

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