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Case report

Transarterial chemoembolization of hepatocellular carcinoma via extrahepatic collateral artery from a supraduodenal and cystic artery trunk, originating from the gastroduodenal artery: A case report☆

*Robert C. Gish, MD, John A. Scott, MD, Hyeon Yu, MD**

Division of Vascular and Interventional Radiology, Department of Radiology, University of North Carolina School of Medicine, 2016 Old Clinic, Campus Box 7510, Chaple Hill, NC 27599, USA

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ABSTRACT

The outcome of transarterial chemoembolization for unresectable hepatocellular carcinoma (HCC) relies on the appropriate identification of tumor supplying arteries. HCC derives 90% of the blood supply from the hepatic arteries. However, depending on the tumor's size and location, the extrahepatic collateral artery (EHC) can develop and predominantly supply the tumor. The supraduodenal artery (SDA) arises from the gastroduodenal artery (GDA). On the other hand, the cystic artery (CA) mostly originates from the right hepatic artery. However, a common trunk of the SDA and CA originating from the GDA and feeding the HCC as an EHC has not been reported. We herein present a 76-year-old man with HCC in segment 6, supplied by an EHC from a common trunk of the SDA and CA originating from the GDA. Selective arteriography confirmed the EHC, which was successfully embolized with drug-eluting beads without complications.

Introduction

Hepatocellular carcinoma (HCC) is the most common primary malignant tumor of the liver and the third leading cause of cancer-related death worldwide [1]. HCC develops in the context of underlying chronic liver disease associated with chronic hepatitis B or C viral infection, non-alcoholic steatohepatitis, and alcohol abuse [2]. Transarterial chemoembolization (TACE) is the most commonly used loco-regional treatment option for unresectable HCCs without portal vein invasion or extrahepatic spread [3]. To achieve the technical success of TACE and the optimal therapeutic outcome, understanding the normal anatomy and variations of the hepatic arteries is essential. In addition, knowledge of the extrahepatic collateral supply (EHC) plays a crucial role in successful treatment. The supraduodenal artery (SDA) is a branch of the gastroduodenal artery (GDA), supplying the anterosuperior as-

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* Corresponding author. H. Yu.
E-mail address: hyeon_yu@med.unc.edu (H. Yu).

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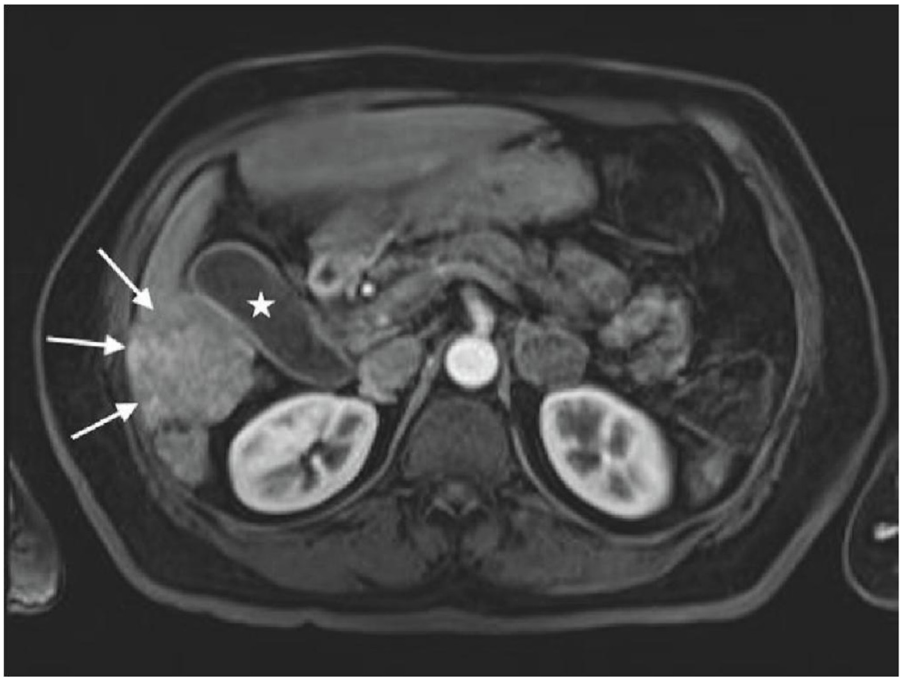

Fig. 1 – An arterial phase of the contrast-enhanced T1-weighted axial MRI of the abdomen demonstrates a hyperintense mass in segment 6 of the right hepatic lobe (arrows) adjacent to the gallbladder (star).

pect of the first and second portions of the duodenum. The cystic artery (CA) typically arises from the right hepatic artery supplying the gallbladder. Although rare, they can supply HCC as an EHC [4,5]. However, an EHC from a common trunk of the SDA and CA, originating from the GDA has not been described. We herein report a case with an HCC in segment 6, successfully treated with TACE via an EHC from a common trunk of the SDA and CA, originating from the GDA.

Case report

A 76-year-old man with chronic hepatitis C and liver cirrhosis who was found to have multiple unresectable HCCs on magnetic resonance imaging (MRI) presented to the Interventional Radiology for a repeat TACE. He had a history of 2 percutaneous microwave ablations of the HCC in May and December 2019 for segment 6/7 HCC. Due to multiple recurrent HCCs in the right hepatic lobe, he underwent the first TACE in April 2020 and transarterial radioembolization (TARE) in July 2020. The patient complained of lethargy, trouble with prolonged daily tasks, and spending prolonged time in bed. He also stated he had vague abdominal pain and a loss of appetite. Additional medical history of the patient included type 2 diabetes mellitus, coronary arterial disease, and hypertension. Laboratory results were the following: alpha-fetoprotein 134 ng/mL (reference range, <8 ng/mL); serum albumin 3.5 g/dL (reference range, 3.5-5 g/dL); total bilirubin 0.6 mg/dL (reference range, <1.2 mg/dL). His Child-Pugh score was 6. The patient's renal function was normal. The most recent MRI of the abdomen in October 2020 demonstrated progression with TR-viable diseases in segments 6 measuring 5.3 cm (Fig. 1). Additionally, 2 lesions in segment 4A measuring 2.9 and 1.4 cm were upgraded to LR-5. The decision was reached at the multidisciplinary conference to carry out additional TACE with drug-eluting beads (DEB).

Left radial arterial access was obtained under ultrasound, and a 5-Fr sheath was placed. The celiac axis was selected with a 5-Fr, 110-cm catheter (Ultimate Radial, Merit Medical OEM, South Jordan, UT). Initial digital subtraction angiography (DSA) from the celiac axis demonstrated conventional anatomy with the celiac axis giving rise to the splenic, left gastric, and common hepatic arteries. The 5-Fr catheter was further advanced into the common hepatic artery, and repeat DSA was performed. It demonstrated the patent GDA and proper hepatic artery, which had a trifurcation with the right, middle, and left hepatic arteries. Attention was initially turned to the middle hepatic artery, which demonstrated a tumoral blush in segment 4A. This lesion was subsequently embolized with DEB containing 50 mg of Doxorubicin through a 2.8-Fr microcatheter (Progreat, Terumo, Somerset, NJ). However, the known segment 6 lesion was not visualized via multiple subselective DSAs from the right hepatic arterial branches. The investigation was then turned to the GDA, giving rise to a common trunk of the SDA and CA (Fig. 2A). Subselective DSA of the GDA demonstrated a tumoral blush in segment 6, supplied by a prominent EHC arising from the common trunk of the SDA and CA (Fig. 2B). This EHC was subsequently catheterized using the microcatheter and successfully treated with DEB until complete stasis (Figs. 2C and D). There were no complications related to non-target embolization, and the patient was discharged the same day of the procedure.

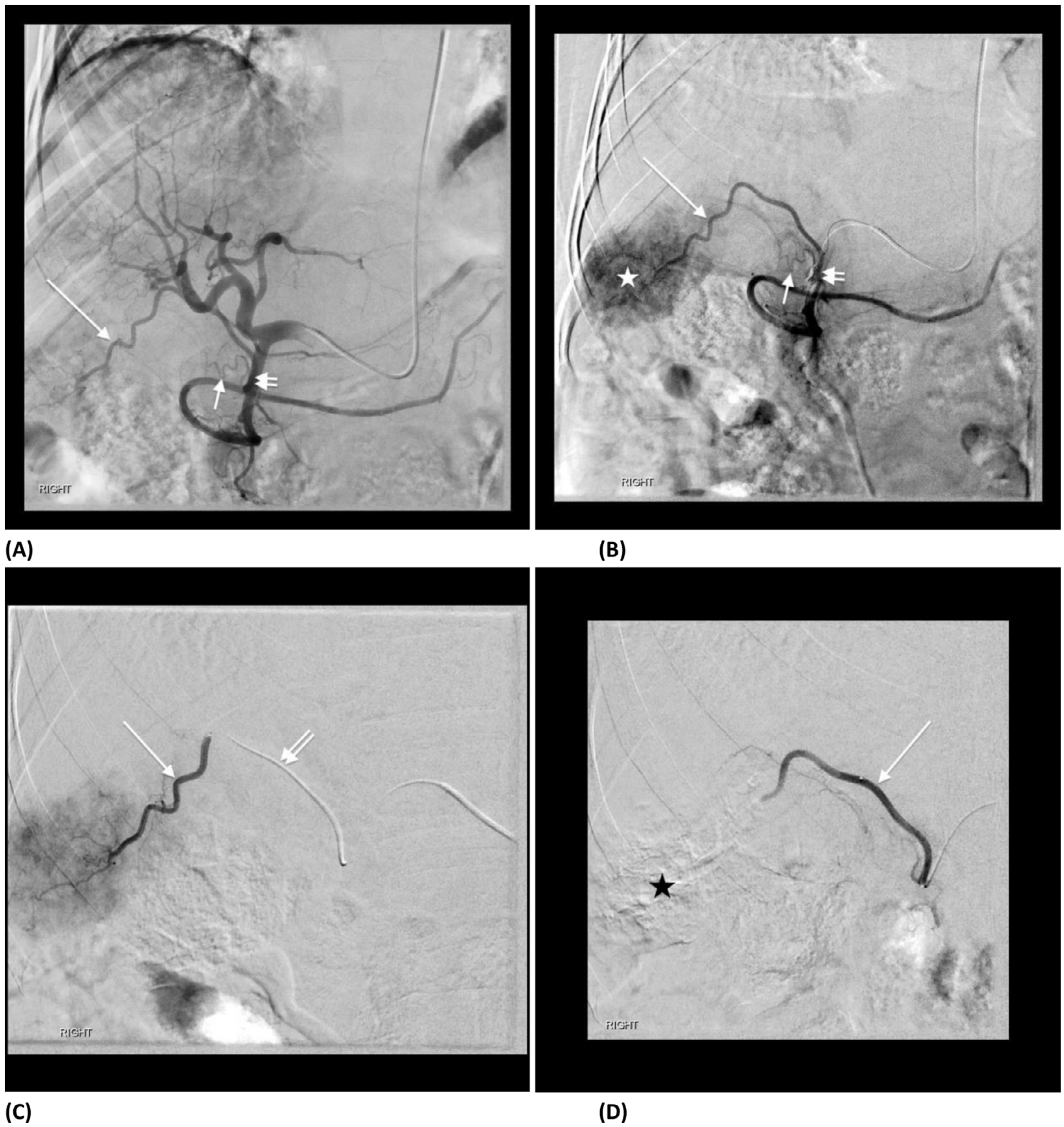

Fig. 2 – (A) A digital subtraction arteriogram obtained from the common hepatic artery shows the extrahepatic collateral artery (long arrow) arising from a common trunk of the supraduodenal (double arrows) and cystic arteries (short arrow), originating from the gastroduodenal artery. (B) A subselective arteriogram of the gastroduodenal artery via a microcatheter demonstrates a tumor blush (star) supplied by the extrahepatic collateral artery (long arrow) from the common trunk of the supraduodenal (double arrows) and cystic arteries (short arrow). (C) The microcatheter (double arrows) is further advanced into the extrahepatic collateral artery (long arrow), and transarterial chemoembolization is performed using drug-eluting beads containing doxorubicin. (D) Post-embolization arteriogram shows complete stasis of the arterial flow in the extrahepatic collateral artery (long arrow) without residual tumor blush (star).

Discussion

Approximately 61% of patients have conventional hepatic arterial anatomy, with the common hepatic artery giving rise to the proper hepatic artery (PHA), GDA, and right gastric artery [6]. The common hepatic artery continues as the PHA after giving rise to the GDA. The PHA then bifurcates into the right and left hepatic arteries or divides into the right, middle, and left hepatic arteries. The CA typically originates from the right hepatic artery with a reported prevalence of 79% [7]. The CA then courses to the right of the common hepatic duct in the cystohepatic triangle and bifurcates into the deep and superficial branches, supplying the gallbladder and cystic duct. The CA can also supply the liver parenchyma at the gallbladder fossa. In a systematic review, Andall *et al*. reviewed a total of 9836 cases and found that 1.9% of the CA originates from the GDA [7]. On the other hand, the SDA most commonly arises from the GDA (55%) and supplies the anterosuperior aspect of the first and second portion of the duodenum [8]. A common trunk of the SDA and CA originating from the GDA is a rare variant that has not been reported to date.

The normal liver receives a dual blood supply from the hepatic artery and portal vein, but HCC derives 90% of the blood supply from the hepatic arteries. Therefore, thorough investigation of the normal and variant hepatic arteries from the celiac axis and superior mesenteric artery is essential for successful TACE and achieving an optimal therapeutic outcome. Besides hepatic arteries, HCC can also be supplied by EHC. According to a retrospective study evaluating EHC in HCC patients, the development of EHC was associated with the tumor size, peripheral location, and the number of previous TACE procedures [9]. In a similar study by Chung *et al*., the tumor size was the major predictor for the development of EHC [5]. The prevalence of EHC drastically increases up to 47% when the tumor size is greater than 5 cm. EHC may develop when peripheral hepatic arteries are attenuated or occluded from multiple TACE procedures [9]. It is also believed that the number of EHC is associated with the number of TACE sessions. HCC in a peripheral location or bare area of the liver is another predictor for the development of EHC. Peripheral HCCs adjacent to the liver capsule have an overall likelihood of 17% of EHC at initial presentation [5]. Zhao *et al.* found that the number of EHC was significantly higher in peripheral HCC than that of central HCC [9]. In the present case, the patient had undergone 2 microwave ablations, 1 TACE and 1 TARE. In addition, the tumor was greater than 5 cm and located peripherally in segment 6, adjacent to the gallbladder, which may have contributed to the development of EHC.

The potential EHC branches include the right inferior phrenic, omental, right adrenal, right renal, left gastric, internal mammary, superior mesenteric, left inferior phrenic, and cystic arteries. Among those arteries, the right inferior phrenic artery is the most commonly encountered EHC, with a prevalence rate of up to 83% [10]. The CA is a relatively rare EHC, found only in 4% of the patients with EHC [10]. The reported technical success rates of TACE through the CA are 70%-92%. The SDA is even rarer, and its prevalence rate is unknown. In our case, HCC in segment 6 was supplied by a single EHC from a common trunk of the CA and SDA, originating from the GDA. This type of EHC has not been reported to date.

Conclusion

We present a case of recurrent HCC in segment 6 supplied by a single EHC from a common trunk of the CA and SDA, originating from the GDA. Subselective DSA of the GDA identified the EHC, through which the TACE was successfully performed to treat the HCC without non-target embolization. It is crucial for interventional radiologists to adequately identify potential anatomical variants of the hepatic arteries and EHC for successful treatment without complications. Therefore, in TACE, when the target tumor is not visualized on DSA via hepatic arteries, subselective DSA from the GDA is recommended to identify a potential rare EHC.

Patient consent

Written informed consent for publication was obtained from the patient.

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