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Case Report

Selection of the right inferior phrenic artery using a dual-lumen microcatheter in transarterial chemoembolization for hepatocellular carcinoma☆

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ABSTRACT

An 88-year-old woman with a history of multiple hepatocellular carcinomas (HCCs) presented with a new HCC in segment seven of the liver. We decided to perform transarterial chemoembolization for HCC. During treatment, the HCC was supplied by the right inferior phrenic artery (IPA), which originated from the proximal part of the left gastric artery with a steep bifurcation angle. Due to the very short distance between the origins of the left gastric artery and right IPA, the microguidewire and microcatheter were unstable in the left gastric artery and easily prolapsed into the celiac artery. Although different types of microcatheters were used, the right IPA could not be selected. Therefore, we used a dual-lumen microcatheter (DLM) to select the right IPA. The DLM stabilized the microguidewire in the left gastric artery, and the right IPA was successfully selected. Subsequently, transarterial chemoembolization was administered using a branch of the right IPA. Given this experience, we will consider using a DLM as an alternative method for selecting an abdominal artery when other techniques are unsuccessful.

Introduction

In transarterial chemoembolization (TACE) for hepatocellular carcinoma (HCC), the importance of embolization of extrahepatic arteries that supply the HCC has been reported [1,2]. Among the various extrahepatic arteries that supply HCC, the most common is the right inferior phrenic artery (IPA) [1,3,4]. Selecting the right IPA is difficult in some patients, and many techniques have been reported [5]. A dual-lumen microcatheter (DLM) is a specialized microcatheter with 2 lumens that allow the control of 2 different guidewires. DLMs

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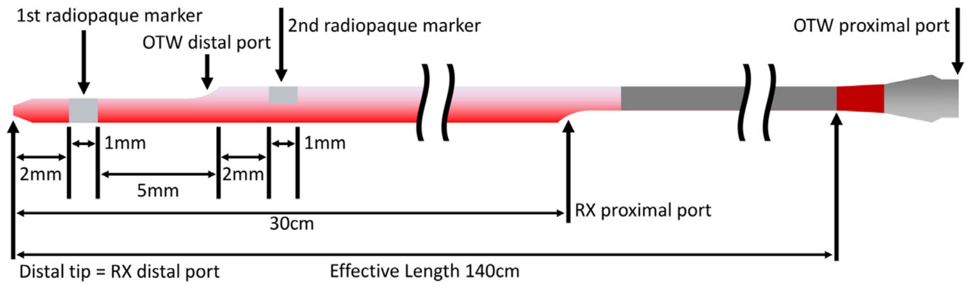

Fig. 1 – A Crusade microcatheter. The catheter has two lumens: an over-the-wire (OTW) lumen and a rapid-exchange (RX) lumen. The OTW distal port is located between the two radiopaque markers. The diameters of the distal and proximal shafts are 2.9-F and 3.2-F.

have been used for complex percutaneous coronary artery interventions, such as the wiring of chronic total occlusion and access to acute angled bifurcations [6]. Although we suspected that a DLM would be useful in arteries other than the coronary arteries, to our knowledge, no study has reported its usefulness in abdominal vascular interventions. The Crusade catheter (Crusade Type R; Kaneka, Osaka, Japan) is a popular DLM in Japan and its structure is illustrated in Fig. 1. Herein, we report a case of TACE for HCC successfully performed via the right IPA using a Crusade catheter.

Case report

An 88-year-old woman with liver cirrhosis due to hepatitis C infection had a history of multiple HCCs, which had been treated with proton beam therapy, radiofrequency ablation, and TACE. The patient presented with a new HCC in segment seven of the liver. We decided to perform TACE for the new HCC.

Under local anesthesia and moderate sedation, a straight-type 4-F guiding sheath (Parent Plus 30; Medikit, Tokyo, Japan) was inserted via the right common femoral artery. The celiac trunk was selected using a 4-F shepherd hook catheter. Computed tomography (CT) angiography of the hepatic artery using a microcatheter with a distal tip of 1.7-F showed no enhancement of the HCC. The HCC was suspected to be supplied by the right IPA, originating from the proximal part of the left gastric artery. Based on pre-TACE CT images, the right IPA seemed difficult to select because of the very short distance between the origins of the left gastric artery and right IPA and the steep bifurcation angle of the right IPA (Fig. 2). A 0.014-inch microguidewire and a 1.7-F microcatheter easily prolapsed from the left gastric artery into the celiac artery, and the right IPA could not be selected. Other microcatheters were also used but were unsuccessful in selecting the right IPA. Specifically, we first used a steerable microcatheter (Leonis Mova; Sumitomo Bakelite, Tokyo, Japan) with a distal tip of 2.4-F and a curved-tip microcatheter, shaped as such using a hot air gun. We then decided to use a Crusade catheter. The guiding sheath was replaced with a shepherd hook-type guiding sheath (Parent Plus30). After engaging the celiac trunk with the sheath, the 1.7-F microcatheter and 0.014-inch guidewire were advanced into the left gastric artery. The microcatheter was removed, and a Crusade catheter was advanced into the left gastric artery along the guidewire through the rapid-exchange lumen. Then, another 0.014-inch, 300-cm-long guidewire was advanced through the over-the-wire (OTW) lumen of the Crusade catheter to select the right IPA. The position of the Crusade catheter was adjusted so that the distal port of the OTW lumen approximated the origin of the right IPA. Because of the Crusade catheter, the 300-cm-long guidewire was stable in the proximal part of the left gastric artery, and manipulation of the guidewire was possible, leading to successful selection of the right IPA (Fig. 3). After removing the Crusade catheter, the 1.7-F microcatheter was advanced over the 300-cm-long guidewire into the right IPA. Angiography of the superior adrenal artery, a branch of the IPA, showed enhancement of the HCC located in segment seven of the liver (Fig. 4). An epirubicin-lipiodol emulsion was injected from the superior adrenal artery, followed by the injection of gelatin sponge particles. CT after TACE revealed dense lipiodol deposition on the lesion. The patient was discharged without complications.

Discussion

A variety of techniques have been reported for the selection of the IPA: creation of a large side hole or cleft in an angiography catheter, turn-back technique, shaping of a microcatheter by steam heating, pre-shaping of a microguidewire into a shepherd's hook form, and balloon blocking technique [5,7,8]. These techniques are intended for use in situations where the IPA arises directly from the celiac trunk. In this case, however, the right IPA arose from the proximal part of the left gastric artery, and the reported techniques might not have worked appropriately. Furthermore, several anatomical characteristics made it difficult to select the right IPA: a very short distance between the origin of the left gastric artery and that of the right IPA and the steep bifurcation angle of the right IPA. Due to the very short distance, guidewire advancement in the left gastric artery was unstable and easily prolapsed into the celiac trunk. We considered that the solution was to stabilize the guidewire in the left gastric artery and enable its manipulation. A DLM placed in the left gastric artery supported the guidewire and resulted in the successful cannulation of

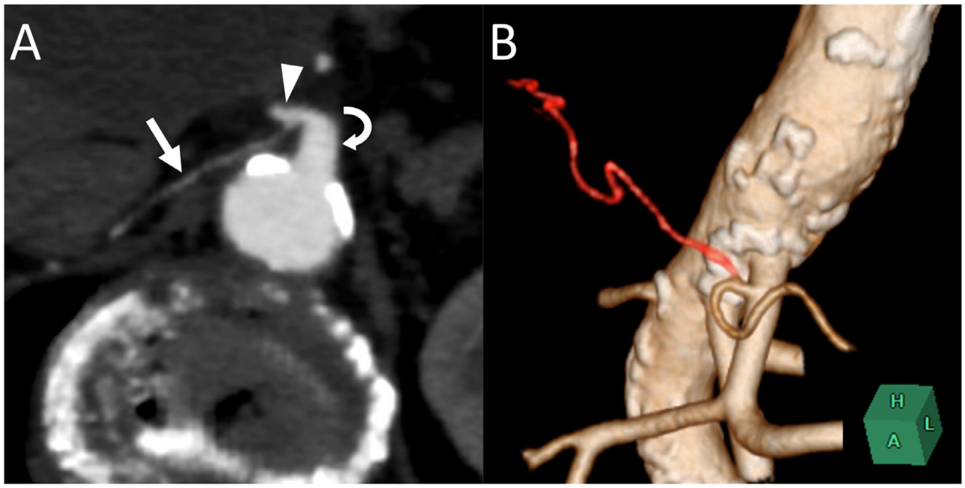

Fig. 2 – Computed tomography (CT) image of the right inferior phrenic artery (IPA). (A) Oblique axial CT image shows the right IPA (arrow) originating from the proximal part of the left gastric artery (arrowhead). The celiac artery is also observed (curved arrow). (B) 3D image from CT shows the right IPA (red) originating from the proximal part of the left gastric artery. (Color version of figure is available online.)

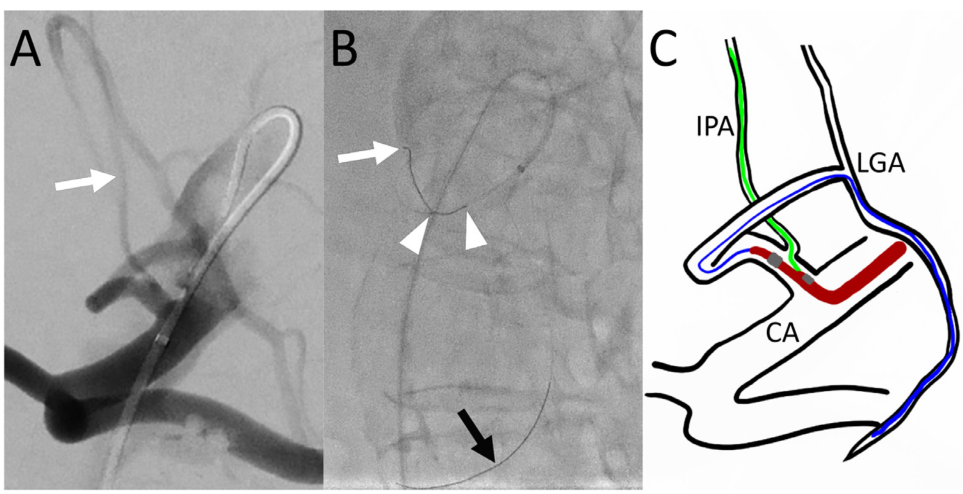

Fig. 3 – Selection of the right inferior phrenic artery (IPA). (A) Angiography of the celiac artery shows the right IPA originating from the proximal part of the left gastric artery. (B) Fluoroscopic image during the selection of the right IPA. The first guidewire (black arrow) is advanced into the left gastric artery. Two guidewires (white and black arrows) are advanced into the left gastric artery and right IPA. The two radiopaque markers of the Crusade catheter are observed (arrowheads). (C) Schematic illustration of the procedure. First, a guidewire (blue) is advanced into the left gastric artery. Subsequently, a Crusade catheter (red) is advanced on the first wire through the rapid-exchange lumen. The position of the catheter is adjusted so that the second guidewire advanced from the over-the-wire lumen can pass into the right IPA. Finally, the second guidewire (green) is advanced into the right IPA. The two radiopaque markers (silver) of the catheter are observed. CA, celiac artery, LGA, left gastric artery. (Color version of figure is available online.)

the right IPA. We believe that a DLM is also effective in the selection of other branches of the abdomen when the target artery is difficult to select because of the unstable position of the guidewire. One disadvantage of the Crusade catheter is that the diameter of the proximal shaft is 3.2-F, and it cannot be advanced through a diagnostic catheter. Thus, the Crusade catheter requires a guiding catheter or sheath. Additionally, the DLM must be replaced with a conventional microcatheter after advancing the guidewire to the target vessel from the OTW lumen, which can be a complicated procedure. This exchange procedure can be performed using a trapping balloon, extension guidewire, and 300-cm-long guidewire.

Fig. 4 – Angiography of the superior adrenal artery, a branch of the right inferior phrenic artery, shows enhancement of the hepatocellular carcinoma (arrows).

Conclusion

Given our experience reported herein, the use of a DLM can be considered an alternative method to select an abdominal artery when it cannot be cannulated using other techniques.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Patient consent statement

Written consent for publication was obtained from the patient.

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