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Research article

Transcatheter arterial chemoembolization of hepatocellular carcinoma in patients with celiac axis occlusion using pancreaticoduodenal arcade as a challenging alternative route

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ABSTRACT

Introduction: Celiac axis occlusion is a challenging condition when catheterization of the hepatic artery is required for chemoembolization of hepatocellular carcinoma (HCC). As a result, the hepatic artery has to be catheterized through the pancreaticoduodenal arcades (PDA) and the gastroduodenal artery (GDA) from the superior mesenteric artery (SMA) which is a tortuous course with acute angles and small caliber branches.

Objective: To assess new techniques for facilitating catheterization of the tortuous PDA and the GDA to reach the proper hepatic artery (PHA) and tumor-feeding branches in patients with celiac axis occlusion undergoing chemoembolization of HCC.

Methods and materials: The study included eleven patients all admitted to do transcatheter arterial chemoembolization (TACE) for treatment of unresectable HCC. During angiography occlusion of the celiac axis was diagnosed and hypertrophied PDA and GDA was noted in SMA angiography. Catheterization of the PDA was performed by preshaping of the micro-guide wire into a wide curve.

Catheterization of the PHA was a challenge and was achieved by reshaping of the micro-guide wire or by looping technique. TACE was done after super selective catheterization of the tumor feeding artery using a mixture of 50 mg of adriamycin, 7cc of lipiodol and gelfoam.

Results: In the eleven patients with celiac artery occlusion, DSA showed complete celiac axis occlusion in all patients. Collateral arteries supplying the liver were readily evident via PDA and GDA from SMA. Successful catheterization of the PHA was achieved in all patients. Chemoembolization was performed to all patients after super selective catheterization of the feeding artery. Follow-up triphasic CT was performed in all patients, 9 patients showed good lipiodol trapping with no residual tumor enhancement. Two patients required another session of TACE.

Conclusion: Chemoembolization of HCC through the PDA and the GDA using micro-guide wire preshaping technique and the microcatheter looping technique in patients with celiac axis occlusion is a challenging but effective treatment for HCC.

1. Introduction

Transcatheter arterial chemoembolization (TACE) is the mainstay of symptomatic palliation for unresectable hepatocellular carcinoma (HCC) without distant metastasis [1]. When the celiac axis is occluded, various collateral pathways develop which usually show compensatory hypertrophy. Of these, the pancreaticoduodenal arcade (PDA) and the gastroduodenal artery (GDA) are the most frequently encountered collateral vessels from the superior mesenteric artery (SMA) [2].

Superselective catheterization of the hepatic artery requires passage through these collaterals which can be very challenging due to their tortuous course and frequent branching at acute angles. This criteria makes it technically difficult to advance a micro-guide wire into the branch vessel or to advance a microcatheter over the inserted micro-guide wire. Sometimes direct catheterization of the proper hepatic artery (PHA) from the GDA is difficult as well due to an acute angle between the GDA and the PHA. Consequently, the excessive manipulation inside the vessel can result in dissection or spasm with failure of catheterization. In addition, multiple trials of catheterization will require more contrast medium to be given to the patient and higher radiation exposure.

We employed new techniques to help us overcome these obstacles

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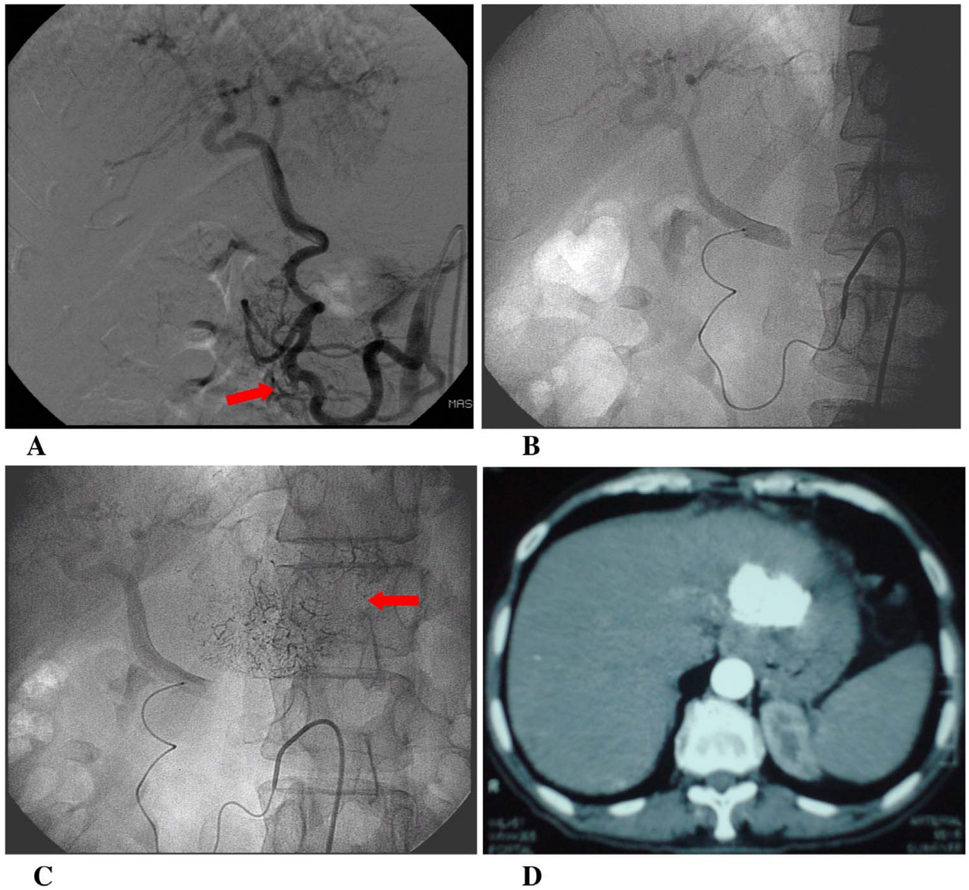

Fig. 1. A) SMA angiogram showing hypertrophied PDA (arrow) supplying the hepatic arteries. B) Microcatheter passing through the arcade reaching the PHA. C) Post TACE angiogram revealed lipiodol trapment in the left hepatic lobe focal lesion (arrow). D) Axial MSCT arterial phase showing good lipiodol trapment with no residual enhancing tumor tissue.

by preshaping of the micro-guide wire and reshaping it as necessary to catheterize the PDA and GDA as well as using the looping technique in which the microcatheter is looped inside the CHA so that its tip enters the PHA to overcome the acute angle between the GDA and the PHA. We report our experience with these techniques to facilitate super-selective catheterization of the tumor-feeding artery and to minimize complications.

2. Objective

To assess new techniques for facilitating catheterization of the tortuous PDA and the GDA to reach the PHA and tumor-feeding branches in patients with celiac axis occlusion undergoing chemoembolization of HCC.

3. Methods and materials

This is a retrospective study which included eleven patients (8 males and 3 females) with a mean age of 40.5 ± 15 years (range: 30–65 years). All patients were diagnosed by triphasic multislice CT of having unresectable HCC and were admitted in Assiut University Hospital in the period from January 2015 to July 2016 to undergo TACE. The ethics committee approval was obtained and all patients signed a written consent form.

Digital subtraction angiography was performed using Artiszee-Siemens Healthcare Angiography system and revealed occlusion of the celiac axis with failure of catheterization in all patients. Catheterization of the SMA was done using 5-French (5F) C2 Cobra catheter and angiography was performed which revealed hypertrophied tortuous PDA and GDA. A microcatheter was used coaxially inside the Cobra catheter to pass through the PDA, however a number of challenges were encountered.

The PDA in most of our patients had tortuous segments of small caliber which posed difficulty in advancing the microcatheter towards the PHA. This was overcome by preshaping the micro-guide wire into a smooth wide curve which enabled it to course through the narrow segments without injuring the wall thus avoiding arterial spasm and dissection (Figs. 1–3). Frequent branching at acute angles was another problem which we solved by withdrawing the micro-guide wire and reshaping it to adapt to each angle.

At the end of the PDA, the micro-guide wire usually passed into the common hepatic artery (CHA) instead of passing into the PHA. Thus we reshaped the micro-guide wire to adapt to the angle of the PHA which was successful in only a few cases. In the other cases we performed the microcatheter looping technique in which the micro-guide wire is passed into the CHA and the microcatheter is advanced into the CHA toward its occlusion. The tip of the microcatheter forms a loop and will then enter the PHA (Fig. 2).

Superselective catheterization of the feeding hepatic artery was done, then TACE was performed using a mixture of 50 mg of adriamycin, 7cc of lipiodol and gelfoam. This was followed by SMA angiogram to confirm tumor vessel embolization.

4. Results

In the eleven patients with celiac axis occlusion, digital subtraction angiography showed complete occlusion in all patients. Collateral arteries supplying the liver were readily evident via the PDA in 9 patients (82%) and the GDA in 2 patients (18%).

Preshaping of the micro-guide wire into a wide curve allowed

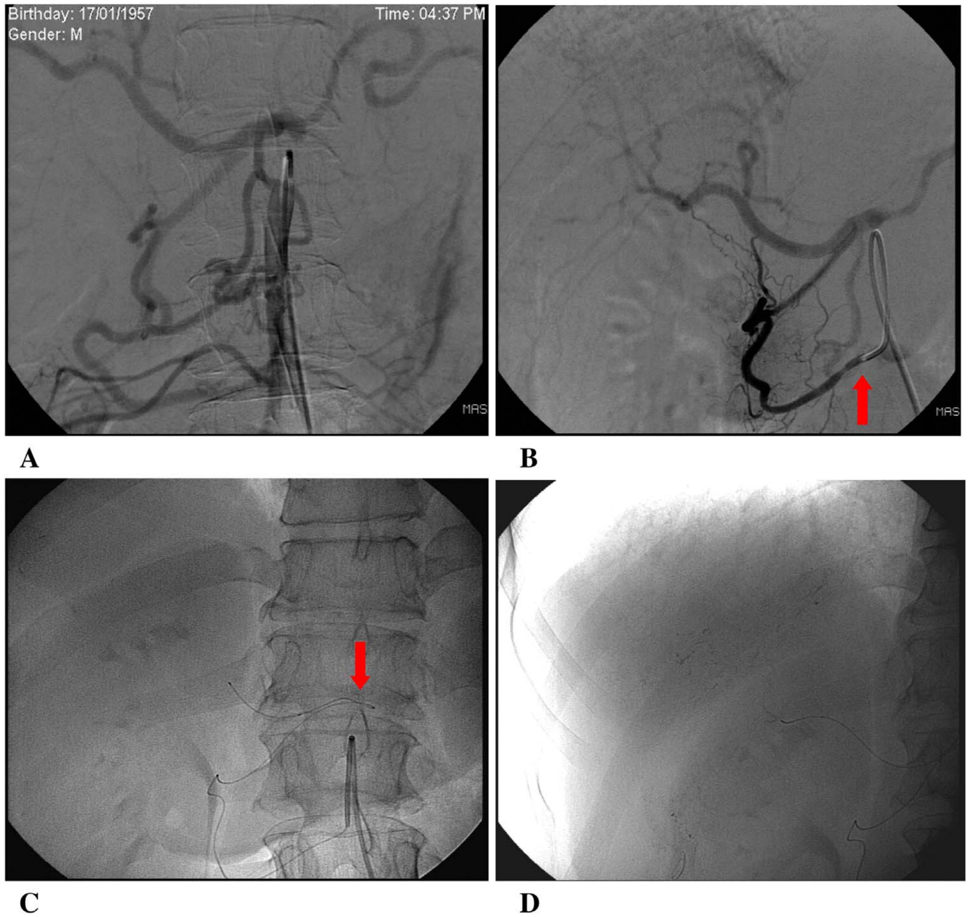

Fig. 2. A) SMA angiogram showing hypertrophied PDA supplying the hepatic and splenic arteries. B) Tip of the catheter is at the inferior PDA (arrow). C) Microcatheter passing through the arcade reaching the RHA using the looping technique (arrow). D) Post TACE showing lipiodol trapment in the lesion.

smooth passage through the narrow segments of the PDA with no complications. Furthermore, reshaping of the micro-guide wire similar to the acute angles in the PDA provided a solution to this challenging problem in all cases.

In order to pass into the PHA from the PDA reshaping of the micro-guide wire was successful in only 3 cases. In 5 cases the reshaping technique was unsuccessful and the looping technique inside the CHA was used instead which proved to be much easier at this point. In the other 3 cases the micro-guide wire passed spontaneously into the PHA (Table 1).

Successful catheterization of the PHA was achieved in all patients followed by superselective catheterization of the feeding artery and finally TACE was performed. Follow-up triphasic CT was done after one month for all patients, 8 patients showed good lipiodol trapping with no residual tumor enhancement. Three patients required another session of TACE. There were no major complications such as arterial dissection. A minor complication occurred in two patients in terms of hematoma at site of puncture.

5. Discussion

Severe stenosis or occlusion of the proximal celiac trunk may be caused by median arcuate ligament compression, arteriosclerosis, pancreatitis, tumor invasion, and celiac axis agenesis. However, clinically significant ischemic bowel disease attributable to celiac axis stenosis/occlusion appears to be rare because the SMA provides for rich collateral circulation [3].

Song et al. [4], concluded that the most common and important collateral vessels from the SMA in patients with celiac axis stenosis are the pancreaticoduodenal arcades and the dorsal pancreatic artery. A communicating channel between the right hepatic artery and the SMA can be a route for collateral circulation. Hepatic artery variations induce unique collateral vessels that are related to the pattern of variation [4]. In our study the PDA was the collateral supply in 82% of the patients followed by the GDA in 18% of the patients.

Catheterization of the celiac axis was not possible in any of our cases in contrast to Kwon et al. [5], who concluded that the celiac artery occlusion could be traversed directly in TACE, since most patients with celiac axis occlusion had arcuate ligament compression.

Baek et al. [6] concluded that using the micro-guide wire preshaping technique, reduces the risk of intimal injury or dissection caused by the catheter as a result of repeated attempts at catheterizing the artery because the catheter does not have a sharp angled tip. When we applied this technique we did not experience any complications with multiple attempts of catheterization in addition to facilitating catheterization of small branches at acute angles.

At the PDA-HA junction the microcatheter looping technique was much easier than the conventional method of preshaping the micro-guide wire in directing the micro-guide wire towards the PHA. This is because the looping technique takes advantage of the natural tendency of the micro-guide wire to pass into the CHA. Yoo et al. also concluded that the conventional method of preshaping a micro-guide wire was inefficient to counteract the passage of the wire into the CHA which forms a more obtuse angle with the GDA [7].

Kiyosue et al. developed a turn-back technique for catheterizing arteries that originate at acute angles [8]. With using this technique, the microcatheter forms a turn in the parent artery and the tip of the microcatheter and the micro-guide wire access the target artery in a retrograde manner. But this method cannot be easily used in the case of accompanying celiac stenosis because it needs enough space to ‘turn

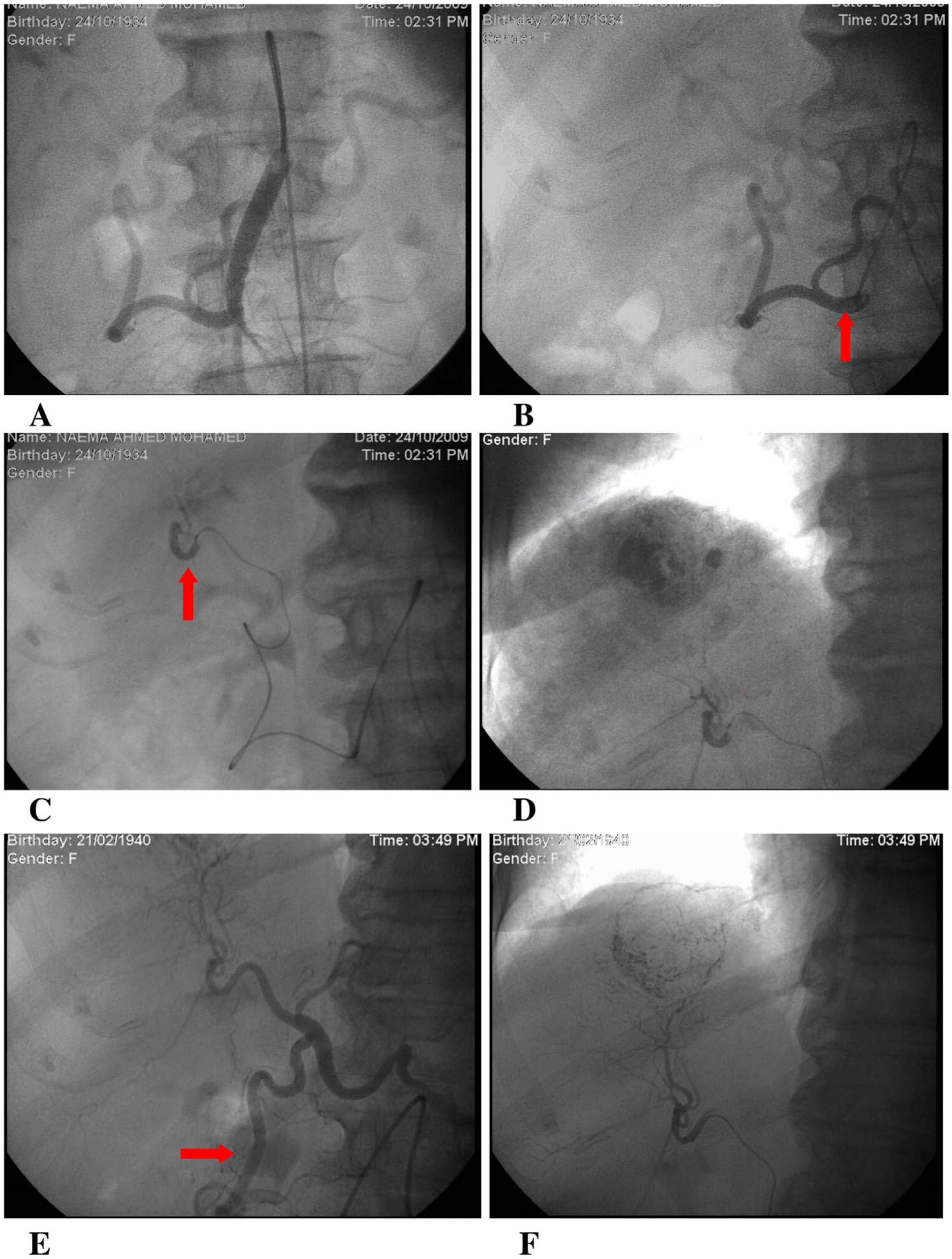

Fig. 3. A) SMA angiogram showing hypertrophied PDA. B) Tip of Simmons catheter seen inside the PDA (arrow). C) Microcatheter passing through the arcade reaching the RHA (arrow). D) Post TACE angiogram showing good lipiodol entrapment inside segment VII HCC. E) The second session of TACE for the same patient showing the tip of the catheter in the PDA (arrow). F) Angiogram after the second session of TACE showing lipiodol trapping with disappearance of pathological vessels.

Table 1
Describing the techniques used and the number of cases performed using each technique.

	Technique Used	Number of Cases
Passing through the PDA and GDA	Preshaping of the micro-guide wire	11
Passing into the PHA from the PDA	Reshaping of the micro-guide wire	3
	Looping technique	5
	Spontaneous passage	3

back' the microcatheters and guide wires.

For all the patients in our study, the targeted arteries were successfully catheterized and satisfactory TACEs were performed. Follow up by triphasic CT was done after one month for all patients, three patients showed residual HCC enhancement and required another session of TACE. Lin Y. and Xiaoming Z. were also able to successfully perform TACE for 9 patients who showed complete occlusion of the common hepatic artery and 2 patients who showed occlusion of the PHA [9].

Although considered relatively safe, TACE has been associated with several complications. These complications are usually divided into hepatic, extrahepatic complications and due to catheter/guide wire manipulation. Some risk factors have been associated with an increase in complications after TACE treatment, the most known being a poor hepatic reserve with increased serum bilirubin levels, the presence of significant intrahepatic biliary dilatation and major portal vein thrombosis. None of our patients had any of these risk factors in addition to using the looping technique and the guide-wire preshaping technique greatly minimized catheter/guide wire manipulation thus no major complications were encountered in this study [10].

In conclusion, it is a great challenge to reach the hepatic arteries in the presence of celiac artery occlusion, however using the looping technique and guide-wire preshaping can facilitate catheterization of the PHA via the PDA in these patients.

References

[1] K. Takayasu, S. Arii, I. Ikai, et al., Liver Cancer Study Group of Japan. P rospective cohor t study of transarterial chemoembolization for unresectable hepatocellular carcinoma in 8510 patients, Gastroenterology 131 (2006) 461–469.

[2] S.Y. Song, J.W. Chung, J.W. Kwon, et al., Collateral pathways in patients with celiac axis stenosis: angiographic-spiral CT correlation, Radiographics 22 (August) (2002) 881–893.

[3] O. Ikeda, Y. Tamura, Y. Nakasone, et al., Celiac artery stenosis/occlusion treated by interventional radiology, Eur. J. Radiol. 71 (August (2)) (2009) 369–377.

[4] Soon-Young Song, Jin Wook Chung, Jong Won Kwon, et al., Collateral pathways in patients with celiac axis stenosis: angiographic–spiral CT correlation, Radiographics 22 (July (4)) (2002).

[5] J.W. Kwon, J.W. Chung, S.Y. Song, et al., Transcatheter arterial chemoembolization for hepatocellular carcinomas in patients with celiac axis occlusion, JVIR 13 (July (7)) (2002) 689–694.

[6] J.H. Baek, J.W. Chung, H.J. Jae, et al., A new technique for superselective catheterization of arteries: preshaping of a micro-guide wire into a shepherd's hook form, Korean J. Radiol. 8 (2007) 225–230.

[7] R.H. Yoo, H.C. Kim, J.W. Chung, Microcatheter looping technique for catheterization of the proper hepatic artery through pancreaticoduodenal arcades and gastroduodenal artery in celiac axis occlusion, Gastrointest. Interv. 2 (2013) 118–120.

[8] H. Kiyosue, S. Matsumoto, Y. Hori, et al., Turn-back technique with use of a shaped microcatheter for superselective catheterization of arteries originating at acute angles, J. Vasc. Interv. Radiol. 15 (2004) 641–643.

[9] L. Yang, X.M. Zhang, Y.J. Ren, et al., The features of extrahepatic collateral arteries related to hepatic artery occlusion and benefits in the transarterial management of liver tumors, Radiol. Res. Pract. 2013 (2013) (Article ID 535272).

[10] Guido Poggi, Emma Pozzi, Alberto Riccardi, Complications of image-guided transcatheter hepatic chemoembolization of primary and secondary tumours of the liver, Anticancer Res. 30 (2010) 5159–5164.