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Techniques in
Vascular and
Interventional
Radiology

Percutaneous Catheter Placement for Hepatic Arterial Infusion Chemotherapy

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Hepatic arterial infusion chemotherapy employs a hepatic artery catheter as a conduit to achieve a high concentration of antineoplastic agents to liver tumors. Historically, this catheter placement has been performed via laparotomy. However, it may now be performed using less-invasive percutaneous image guided procedures. There are many anatomical hepatic arterial variations and complicated blood flow patterns. Various techniques are required to ensure high concentration of antineoplastic agents in liver tumors. These techniques are composed of arterial redistribution by embolization, percutaneous catheter placement applying "tip-fixation method," and evaluation and management of flow patterns that reflect drug distribution. The role of interventional radiologists in hepatic arterial infusion chemotherapy is to create and manage the access to achieve these objectives.

KEYWORDS arterial infusion chemotherapy, arterial redistribution, tip-fixation, port system, drug distribution

The purpose of hepatic arterial infusion chemotherapy is to decrease the side effects of antineoplastic agents whereas at the same time achieving a better tumor response through increased drug concentration in the liver. The pharmacokinetic rationale behind hepatic arterial infusion chemotherapy is explained by two theories, the "first pass effect" and the "increased local concentration without first pass effect."[1] By using the transarterial route of administration, we can achieve more than 10-fold increases in drug concentration within the liver as compared with that achieved through the intravenous route. However, to realize these theoretical benefits in patients, regardless of patients' vascular variations, the "optimal drug distribution" (ie, the administered drug is distributed only to the liver and never to the extra-hepatic organs in repeated administrations) must be obtained. From this point of view, hepatic arterial infusion chemotherapy is a therapy largely based on technical factors. Therefore, the role of interventional radiologists in hepatic arterial infusion chemotherapy is to provide techniques that realize this "optimal drug distribution," and ensure that clinical outcomes from this treatment modality have been maximized. To help achieve these goals, this article reviews the relevant hepatic arterial anatomy, specific techniques used for percutaneous catheter placement, and how to evaluate and manage alterations of hepatic arterial blood flow and drug distribution before and after the therapy has been initiated, respectively.

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Techniques for Percutaneous Catheter Placement

Techniques for percutaneous catheter placements are constructed by three distinct processes: (1) arterial redistribution, (2) percutaneous catheter placement, and (3) evaluation and management of drug distribution. After all three processes are performed, the "optimal drug distribution" can be achieved.

Arterial Redistribution

The purposes of arterial redistribution are (1) to convert multiple hepatic arteries when present into a single vascular supply and (2) to occlude nontarget arteries arising from the hepatic arterial region and/or supplying extra-hepatic organs that may have a negative effect on the "optimal drug distribution."[2-4]

Conversion of Multiple Hepatic Arteries into a Single Vascular Supply

For patients with multiple hepatic arteries, all except the one to be infused with chemotherapy must be embolized by steel

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doi:10.1053/j.tvir.2007.08.007

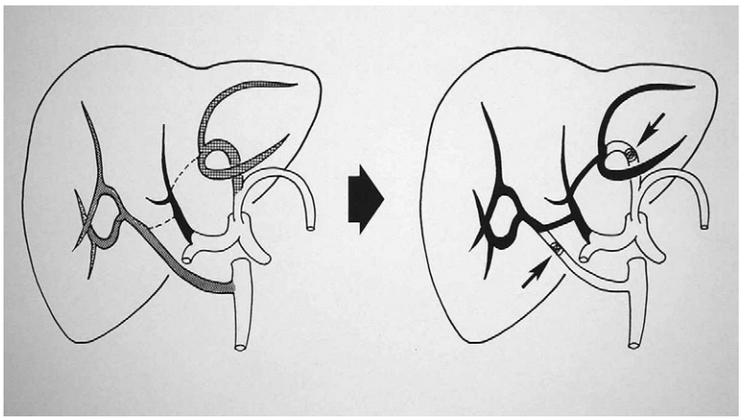

Figure 1 There must be intrahepatic arterial communications between multiple hepatic arteries, thus, the liver area where the feeding artery is embolized receives arterial blood supply through intrahepatic communications from the next hepatic artery. By this mechanism, the entire liver changes to receive arterial blood supply via remaining one hepatic artery.

coils and/or liquid embolic material such as n-buyl-2-cyanoacrylate (NBCA) mixed with lipiodol. The most commonly found cases with multiple hepatic arteries are the replaced right hepatic artery (rep. RHA), an accessory right hepatic artery (acc. RHA) that arises from either the superior mesenteric artery (SMA) or the common hepatic artery (CHA), and a replaced left hepatic artery (rep. LHA) or accessory left hepatic artery (acc. LHA), that arises from the left gastric artery (LGA). Because intrahepatic arterial communications exist between multiple hepatic arteries, the vascular territory where the feeding artery has been embolized still receives arterial blood supply from the patent hepatic artery such that the hemodynamics of the entire liver changes to receive arterial blood supply from the one remaining hepatic artery. For this reason, the liver can be completely perfused by a single indwelling catheter (Figs 1 and 2).

In cases where the proper hepatic artery (PHA) bifurcates into two hepatic arteries and either a replaced or accessory hepatic artery is present, the replaced or accessory hepatic artery should be embolized to make the PHA the remaining artery. Similarly, in cases where the PHA trifurcates within the liver, and two replaced or accessory hepatic arteries are found, the replaced or accessory hepatic arteries should be embolized. Because the incidence of vascular occlusion is quite high when an indwelling catheter is placed within a replaced or accessory hepatic artery, it may be difficult to

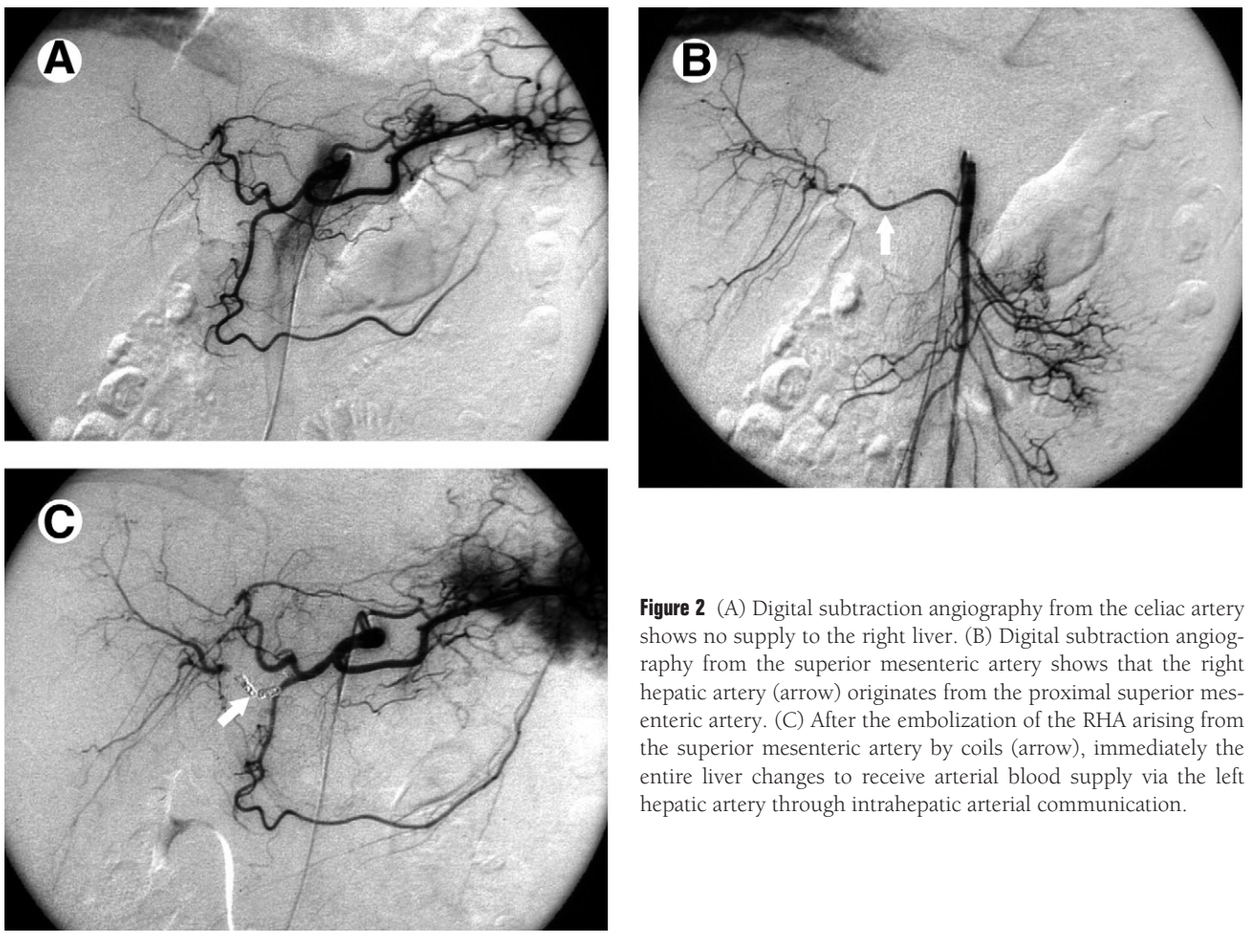

Figure 2 (A) Digital subtraction angiography from the celiac artery shows no supply to the right liver. (B) Digital subtraction angiography from the superior mesenteric artery shows that the right hepatic artery (arrow) originates from the proximal superior mesenteric artery. (C) After the embolization of the RHA arising from the superior mesenteric artery by coils (arrow), immediately the entire liver changes to receive arterial blood supply via the left hepatic artery through intrahepatic arterial communication.