Journal of Visceral Surgery (2014) **151**, S17—S20

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

REVIEW

Surgical or percutaneous hepatic artery cannulation for chemotherapy

T. De Baere[a], **P. Mariani**[b,*]

[a] *Département de Radiologie Interventionnelle, Institut Gustave-Roussy, 39, rue Camille-Demoulins, 94905 Villejuif, France*
[b] *Département de Chirurgie, Institut Curie, 26, rue d'Ulm, 75248 Paris cedex 05, France*

Available online 24 February 2014

KEYWORDS
Intra-arterial chemotherapy;
Interventional radiology;
Surgical technique

Summary The principle underlying administration of hepatic arterial chemotherapy (HACT) is to increase the local concentration of cytotoxic chemotherapy while limiting systemic toxicity. The chemotherapy agent is infused into the hepatic artery distal to branches that serve the stomach, duodenum, and pancreas. The intra-arterial catheter is connected to a subcutaneously implanted reservoir to allow repeated sessions of chemotherapy. Percutaneous placement is now a reliable and reproducible technique in the hands of well-trained interventional radiologists. Hepatic arterial cannulation by an open surgical approach is currently reserved for cases where the decision for HACT is made in the course of an hepatic surgical procedure.

The principle underlying administration of hepatic artery chemotherapy (HACT) is to increase the local concentration of cytotoxic chemotherapy while limiting systemic toxicity. The chemotherapy agent is infused directly into the hepatic artery (HA) distal to branches serving the stomach and duodenum. If there are multiple hepatic arteries (20% of the population), one of these arteries is occluded or ligated proximally to allow redistribution through the remaining artery, supplying the entire liver via intraparenchymal arterial shunts that open almost immediately. The intra-arterial catheter is connected to a subcutaneously implanted reservoir to enable repeated sessions of chemotherapy.

The catheter may be placed either surgically by laparotomy or laparoscopy, or percutaneously, under radiologic guidance.

Surgical technique

Preoperatively, anatomy is assessed by abdominopelvic CT scan in the early arterial phase after IV contrast injection to detect any anatomical variations.

* Corresponding author.
E-mail address: pascale.mariani@curie.net (P. Mariani).

1878-7886/$ — see front matter © 2013 Elsevier Masson SAS. All rights reserved.
http://dx.doi.org/10.1016/j.jviscsurg.2013.12.004

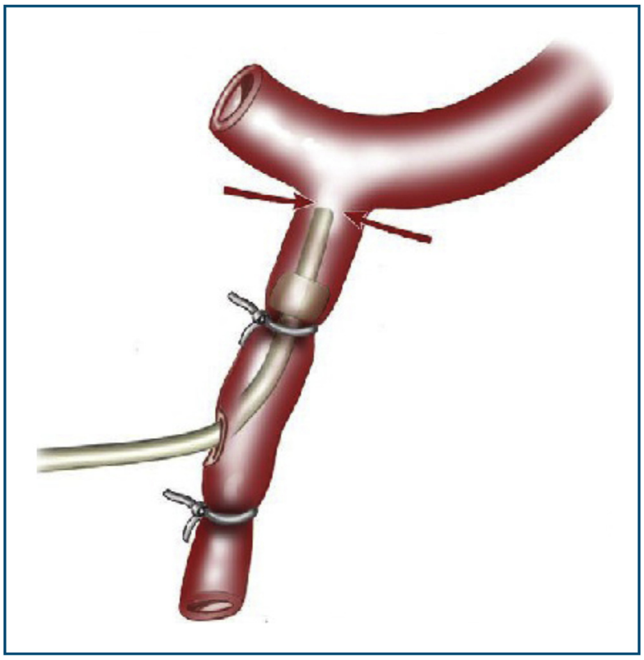

Figure 1. Surgically placed catheter with the catheter tip lying flush at the origin of the gastroduodenal artery.
From C. Honoré et al., Catheter placement for intra-arterial hepatic chemotherapy. Journal of Visceral Surgery 2012.

The technique for open surgical placement of a catheter for HACT was described in detail by the surgical team at the Gustave-Roussy Institute in the November 2012 *Journal of Visceral Surgery* [1]. We therefore outline here only the main principles.

The approach depends on whether surgical procedures are to be performed in association with intra-arterial catheter placement. If catheter insertion alone is planned, a short right subcostal incision is sufficient. After elevating the liver margin, the hepatic pedicle and the lesser omentum are palpated to detect the presence of a right or left HA; the lesser omentum is then incised from the hepatic pedicle to the right diaphragmatic pillar. Cholecystectomy is systematically performed to prevent complications of gallbladder toxicity or necrosis.

The bifurcation of the common HA giving rise to the proper HA and the gastroduodenal artery (GDA) is dissected. All branches of the GDA serving the pylorus, duodenum and pancreas are ligated to prevent extra-hepatic infusion of chemotherapy. The right gastric artery is also ligated. The GDA is then freed circumferentially over a length of 2 cm from its origin and its distal end is ligated. After placement of a small atraumatic bulldog clamp at the origin of the GDA, a 3 mm to 1 cm longitudinal arteriotomy is performed. The catheter (6.5 French Celsite, T202F, B BRAUN), pre-flushed with heparin, is inserted so that its tip lies just at the level of the origin of the GDA without projecting into the common HA or proper HA. The catheter is secured in place by a non-absorbable suture ligature just distal to the proximal spur (Fig. 1). The catheter is connected to the reservoir, leaving adequate slack so that the catheter is flexible without deformation. The reservoir, pre-flushed with heparinized saline, is implanted beneath the skin, taking care to place it at some distance from the pedicle to avoid radiologic superimposition during opacification. The system is tested with a low-pressure injection of fluorescein to verify that the entire liver is perfused without extra-hepatic distribution. The technique may require modifications in case of anatomical variation. These modifications allow the realization of total hepatic perfusion by implantation of a catheter into a single HA whenever multiple hepatic arteries are present.

The surgical implantation technique has also been described by laparoscopy [2] and with robotic assistance, with promising results [3].

Radiology-guided technique

The percutaneous route for radiology-guided HA cannulation has evolved from the initial transaxillary approach to the more recent transfemoral approach, with placement of the subcutaneous reservoir on the chest wall or the lower abdominal wall [4—6].

The transaxillary route was preferred initially due to greater ease of insertion of the catheter into the HA from above (no acute angle between the celiac trunk and the HA) [7]. However, this approach results in a higher rate of complications: arterial aneurysms requiring stent in 3%, axillary artery thrombosis, and ischemic strokes in 0.5—1% [4,5,8]; this has led most teams to prefer the transfemoral approach.

Hepatic artery catheterization via the femoral approach is technically more difficult but it can now be achieved in most patients due to improvements in endovascular navigation made possible by newly available materials. The femoral approach allows redistribution of the arterial flow to obtain total liver perfusion through a single HA in order to deliver therapy to the entire liver and the liver alone. Monopediculisation means that, in case of multiple hepatic arteries, the accessory HA or arteries must be occluded proximally, usually by injection of coils. When multiple hepatic arteries are present, the catheter is positioned in the artery that gives rise to the GDA or to the largest diameter vessel. Any extra-hepatic perfusion of the stomach, duodenum and pancreas should be avoided. Thus, any hepatic arterial branches downstream of the catheter placement should be embolized. The distal GDA and right gastric artery must always be embolized. Cystic artery embolization remains controversial except in cases when a large cystic artery is easily accessible. In four series involving 250 patients, no cases of acute cholecystitis have been reported despite the absence of prior cystic artery embolization [4,6,9,10].

The intra-arterial catheter should not be placed free-floating in the lumen of the HA due to the high risk of tip migration. We generally position the catheter tip as distally as possible in the GDA to ensure its stability [10]. The pre-formed catheter contains a side hole 20 cm from its distal end. The catheter must be shortened (on average, 7—8 cm from the distal end) so that the lateral hole lies facing the proper HA.

In practice, after initial angiography and occlusion of accessory hepatic artery (ies) and the right gastric artery, the GDA is catheterized distally, downstream of the right gastro-epiploic branch, with a microcatheter. The micro-catheter is mounted on a 0.018-inch rigid guide, which will be used to insert the chemotherapy catheter. The distal GDA is occluded later, beyond the previously inserted catheter using 0.018-inch coils. When the GDA cannot be cannulated, is absent, or has been previously ligated, the distal end of the chemotherapy catheter can be placed in a peripheral branch of the HA, positioning the side hole in the proper HA. Angiography is performed to verify that the catheter is