

The Importance of Route Anatomic Variants of the Common Hepatic Artery

Șerban Marinescu¹, Bogdan Tănase¹, Ciprian Cirimbei^{1,2}, Laurențiu Simion^{1,2*}

¹"Prof. Dr. Al. Trestioreanu" Institute of Oncology, Bucharest, Romania

²"Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

*Corresponding author:
Associate Professor Dr. Laurențiu
Simion, M.D., Ph.D.
"Carol Davila" University of Medicine
and Pharmacy – Bucharest, Romania
"Prof. Dr. Al. Trestioreanu" Institute of
Oncology, Bucharest, Romania
252 Fundeni Road
E-mail: lasimion@yahoo.com

Rezumat

Importanța variantelor anatomice de traseu ale arterei hepatice comune

Introducere: În literatură sunt descrise numeroase variante de vascularizație la nivelul trunchiului celiac și arterei mezenterice superioare. Anatomia zonei este un subiect de studiu, având în vedere impactul potențial asupra tehnicilor chirurgicale și riscul de a genera incidente/accidente intraoperatorii sau complicații.

Material și Metodă: Am efectuat un studiu retrospectiv unicentric, în Clinica de Chirurgie 1 a Institutului Oncologic "Prof. Dr. Al. Trestioreanu" București, pe un interval de 11 ani, privind incidența acestei rare anomalii de traseu a arterei hepatice comune, incidență ce este evaluată în literatură la aproximativ 0,1%. Studiul a avut două componente, pe de o parte verificarea înregistrărilor din documentele medicale (condiții de operații, în principal), pe de altă parte discuții de tip focus-grup cu cei 19 medici chirurghi ai secției privind experiența operatorie personală a fiecăruia. Am identificat două cazuri în care s-a întâlnit această anomalie de traseu al arterei hepatice comune, adică varianta de traseu retroportal. Cazurile sunt complet documentate, inclusiv imagistic și sunt prezentate pe scurt.

Rezultate: Variantele anatomice ale trunchiului celiac reprezintă un subiect extrem de studiat, având în vedere implicațiile majore în chirurgia hepato-bilio-pancreatică și a transplantului hepatic. Variantele de traseu sau de origine ale arterei hepatice pot fi cauza a numeroase incidente și accidente atât în chirurgia oncologică hepato-bilio-pancreatică, dar și în cea a traumei. Nerecunoașterea variantelor anatomice, preoperator sau intraoperator, se poate

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solda cu leziuni vasculare importante, mai ales ale venei porte, ce pot complica foarte mult timpul de rezecție.

Concluzii: Variantele de traseu ale arterei hepatice sunt deosebit de importante în chirurgia de transplant hepatic, chirurgia oncologică hepato-bilio-pancreatică sau gastrică, procedurile de radiologie intervențională, dar și în chirurgia traumei, mai cu seamă a leziunilor penetrante abdominale supravezicologice. Ideal este că aceste variante anatomice să fie recunoscute preoperator și astfel să se poată adopta tehnica de abord chirurgical cea mai potrivită.

Cuvinte cheie: variante anatomice, artera hepatică comună, traseu retroportal

Abstract

Introduction: Variants of vascularization in the celiac and upper mesenteric artery are described in the dedicated literature. The anatomy of this area is a subject of interest, considering the potential techniques and the risk of generating intraoperative incidents/accidents or complications.

Material and Method: We have conducted a unicentric retrospective study, in the Surgery Clinic No.1 of "Prof. Dr. Al. Trestioreanu" Institute of Oncology from Bucharest, on an 11-year interval of time, concerning the occurrence of this rare route-related anomaly of the common hepatic artery, incidence which is evaluated in the dedicated literature at about 0.1%. The study consisted of two components, namely the relevant medical records, on the one hand and focus-group discussions with the 19 surgeons of our department regarding their personal operating experiences, on the other hand. We have identified two cases where this route abnormality of the common hepatic artery, i.e. the retroportal route variant, has been encountered. These two cases are fully documented, including CT-scan and intraoperative images, and they are briefly presented hereinafter.

Results: Anatomical variants of the celiac trunk represent an extremely researched topic, considering the major implications in hepato-pancreato-biliary surgery and liver transplantation. Variants of route or origin of the hepatic artery can be the cause of numerous incidents and accidents in hepato-pancreato-biliary oncology surgery, but also in that of trauma. Non-recognition of anatomical, preoperative or intraoperative variants can result in important vascular lesions, especially of the portal vein, which can greatly complicate the resection time.

Conclusions: Route variants of the hepatic artery are particularly important in liver transplantation, hepato-pancreato-biliary or gastric oncology surgery, interventional radiology procedures, but also in trauma surgery, especially in case of supramesocolic abdominal penetrating lesions. It would be ideal for these variants to be recognized before surgery, so that the most appropriate surgical technique can be adopted.

Key words: anatomical variants, common hepatic artery, retroportal route

Introduction

The anatomy of the celiac region and variations in vascularization in the celiac trunk and upper mesenteric artery are a subject of study, many variants of both origin and route being described, with different impact on surgical techniques, given that the common hepatic artery (CHA) and the proper hepatic artery

(PHA) are important intraoperative landmarks for dissection in the liver pedicle.

Common or proper hepatic artery with retroportal routes are rare variants, but they can cause difficulties and intraoperative accidents.

The first variations of the celiac trunk were described by Haller in 1756 and Michels in 1966 and Hiatt in 1994 described anatomical

variations of origin and branching of the celiac trunk and upper mesenteric artery (AMS) (1,2). A comparison of the two classifications can be seen in *Table 1*.

To be familiar with possible anatomical variants of the hepatic artery is of vital importance in hepato-pancreato-biliary surgery, liver transplantation, trauma, but also in interventional radiology (3,4). Lack of familiarity with such anatomical variants predisposes to the occurrence of accidents and incidents, both in surgery and percutaneous procedures.

Material and Method

We have conducted a unicentric retrospective analysis, in the Surgery Clinic 1 of "Prof. Dr. Al. Trestioreanu" Institute of Oncology, over an interval of 11 years, respectively January 2010 - December 2020, evaluating both medical records and surgeons' personal experience.

The study of medical records mainly involved the analysis of the operating protocols, focusing on procedures addressed to the hepato-pancreato-biliary or gastric pathology. It should be noted that during the study period the surgical procedures were mostly scheduled and oncological. No liver transplant surgery or interventional radiology procedures were performed in the clinic.

At the same time, we also conducted a retrospective focus group study, interviewing 19 senior general surgeons who were active during the time period of the study, in the Surgery Clinic 1 of the "Prof. Dr. Al. Trestioreanu" Institute of Oncology from Bucharest. The questions concerned personal cases, regarding the anatomical variants of the common hepatic artery, found in interventions in the hepato-pancreato-biliary sphere. Given the rarity of these cases, it is extremely likely that the surgeons, if they have encountered such anatomical variants, they will remember.

Pursuant to these analyses, we identified two cases in which we could document route variants of the common liver artery, namely the retro-portal route.

Table 1.

Anatomic variant	Michels classification	Hiatt classification
normal	Type I	Type I
LHA from LGA	Type II	Type II
RHA from SMA	Type III	Type III
LHA from LGA and RHA from SMA	Type IV	Type IV
LHA accessory from LGA	Type V	Type II
RHA accessory from SMA	Type VI	Type III
LHA accessory from LGA and RHA accessory from SMA	Type VII	Type IV
accessory LHA from LGA and RHA from SMA	Type VIII	Type IV
CHA from SMA	Type IX	Type V
LHA and RHA from LGA	Type X	-
CHA from the aorta	-	Type VI

LHA – left hepatic artery

RHA – right hepatic artery

SMA – superior mesenteric artery

LGA – left gastric artery

CHA – common hepatic artery

Results

The retrospective unicentric study enabled us to identify, within the 11-year interval, only two cases of common hepatic artery with retroportal route, cases that we could fully document, including by means of relevant images. It should be mentioned, one more time, that the specificity of the surgery performed in the clinic during the said period is scheduled oncologic surgery.

The first patient, aged 61, with a history of laparoscopic splenectomy 2 years ago for autoimmune hemolytic anemia, was hospitalized in our clinic for epigastric pain, loss of weight, and lack of appetite. Superior digestive endoscopy revealed the presence of a vegetative tumor of the gastric body. The CT scan raised suspicion of invasion of the pancreatic tail, but without liver or peritoneal metastases.

Intraoperatively, a gastric body tumor was found, invading the pancreatic tail, without liver or peritoneal metastases. Total gastrectomy, distal pancreatectomy and regional lymphadenectomy were performed. The hepatic pedicle was approached, identifying the proper hepatic artery, which was placed to the right of the portal vein. Continuing the dissection, the retroportal route of the common hepatic artery was identified

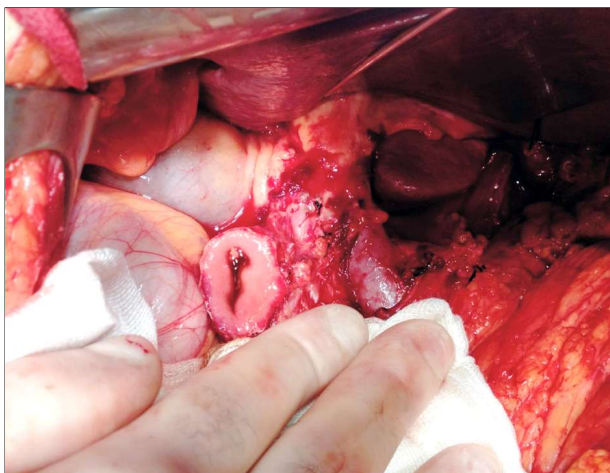


Figure 1. Intraoperative image. The resection time is over. The caudate lobe, the sectioned duodenum, the portal vein, the common hepatic artery and the proper hepatic artery can be observed

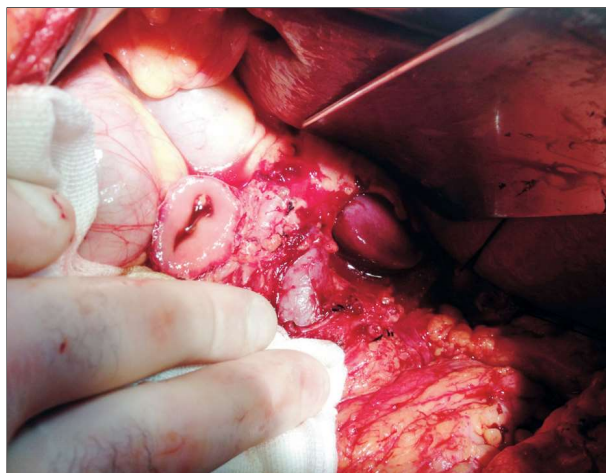


Figure 2. Intraoperative image. At the time of the approach of the celiac trunk and the common hepatic artery, in order to achieve regional lymphadenectomy, the retroportal trajectory of the common hepatic artery is observed

(Figs. 1, 2). Careful examination of the preoperative CT scan revealed the anomaly of the route of the common hepatic artery (Fig. 3). In the postoperative evolution, a pancreatic leak occurred, but it was resolved by means of conservative treatment.

The second patient identified, aged 26, came for morning hypoglycemia, which turned out to be basal hyperinsulinemia. The CT scan showed a 3 cm pancreatic head tumor, native isodense, postcontrast hyper dense. The CT

scan also reveals the hepatic artery with retroportal route (Fig. 4).

The surgical intervention allowed the enucleation of the tumor formation, with intraoperative histo-pathological examination, which revealed the presence of malignant cells (Figs. 5, 6, 7). The intervention continued with pancreaticoduodenectomy. During the maneuvers to identify the gastro-duodenal artery, the retroportal common hepatic artery was found, with the appearance of the gastro-



Figure 3. Preoperative CT scan with contrast substance. The hepatic artery with retroportal route is observed

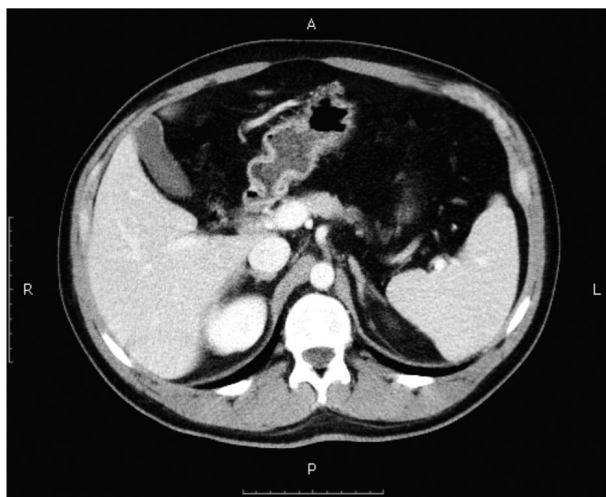


Figure 4. CT scan with preoperative contrast substance, representing the retroportal route of the common hepatic artery

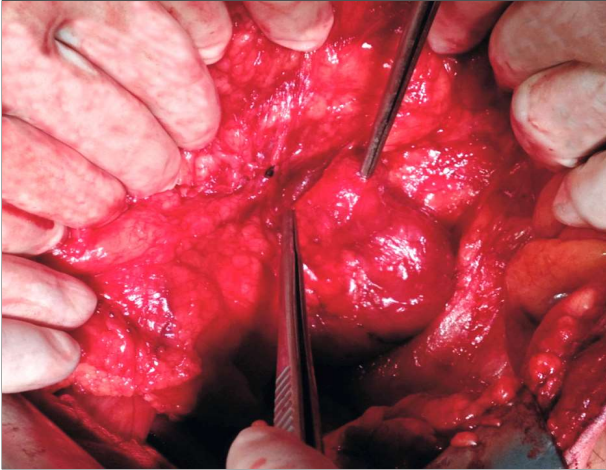


Figure 5. Intraoperative image. The head of the pancreas is observed, upon which a tumor of approx. 3 cm. can be identified, tumor which is relatively well delineated from the rest of the parenchyma

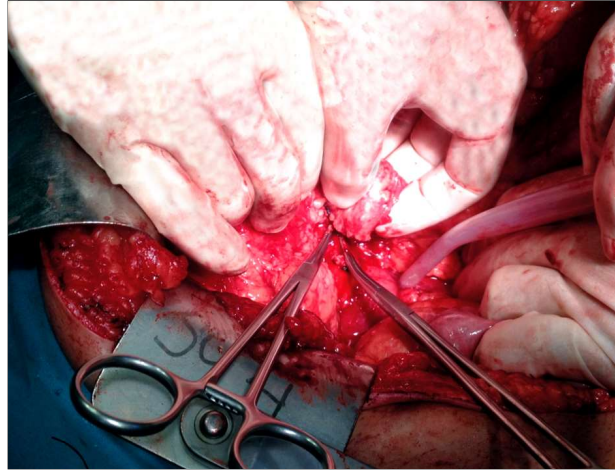


Figure 6. The tumor is resected and then sent to the laboratory for intraoperative hystopathologic examination

duodenal artery in the right side of the portal vein (*Fig. 8*). The restoration of digestive continuity was achieved by termino-terminal pancreatico-jejunal anastomosis by intubation, hepatico-jejunal anastomosis termino-lateral performed by Witzel technique and precolic termino-lateral gastro-entero anastomosis. The patient's post-surgery evolution was uneventful.

Discussions

The incidence of anatomical variants in the hepatic artery is very high, its level amounting to around 39%, according to Saba L and Mallanani G (5). The study published by the two authors in 2011 is a radiological one and took into account 1910 patients, investigated between 2004 and 2009.

A search made in the Pub Med database by entering the keywords: "retroportal common liver artery" led to a number of 26 results, of which only 5 were significant. Thus, we have identified in the literature 13 cases of common hepatic artery with retroportal route.

Anatomical variants of the celiac trunk are a highly researched topic, considering the major implications in hepato-bilio-pancreatic surgery and liver transplantation.

Thus, in 1969 Vandamme JP, Bonte J and

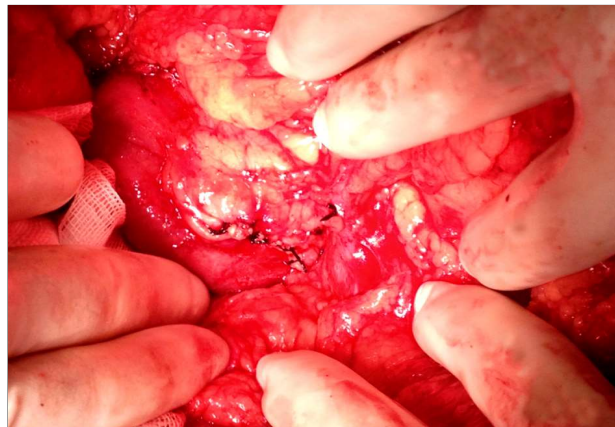


Figure 7. Intraoperative aspect after the resection of the cephalopancreatic tumor

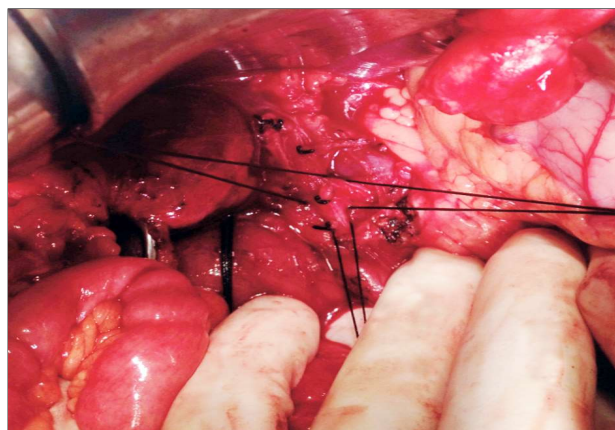


Figure 8. The common hepatic artery appears from under the portal vein, giving rise immediately to the gastroduodenal artery

Van der Scheueren G. published an anatomical study of hepatic artery variations, carried out by analysis of a number of 156 cadavers(6) and in 1971 the same topic was treated by Suzuki et al. based on 200 patients, studied angiographically (7).

The most important radiological study was published by Song et al. in 2010 and was performed on a number of 5,002 patients. The results showed normal anatomy of the celiac trunk in 89.1% of cases and 13 possible anatomical variants (8). The common hepatic artery with celiac origin was found in 4,763 patients; in case of 7 of the said patients, variants of trajectory were identified: retroportal route - 6 cases, intrapancreatic route - 1 case. So, according to this study, the hepatic artery with retroportal route is a very rare eventuality, found in 0.1% of cases.

In 2013, another radiological study, which took into account 600 patients, revealed normal anatomy of the celiac trunk in 91% of cases (546 cases), with normal pre-portal route of the common hepatic artery in 97.78%, with the retro-portal route being found in 7 patients (1.1%) (4).

Another anatomical study, conducted on 45 cadavers between July 2010 and April 2011 in Brazil, revealed variants of the liver artery in approx. 40% of cases (9). After having studied a number of 200 bodies, Michels identified the presence of anatomical variants in 45% of cases (10).

Other data from the literature dedicated to this matter, such as the study by Hiatt et al., which included a number of 1,000 patients who were to receive a liver transplant, suggested a value of 24.3% for anatomical variants of the hepatic artery (11). A study conducted on 527 donors for liver transplantation identified abnormalities in 30.6% of cases (12). Chaib advances the figure of 39%, obtained by studying 80 donors (13).

Preoperative evaluation of patients is extremely important, the CT scan with contrast substance being a safe and extremely effective method for highlighting the anatomical variants of the hepatic artery (14), thus allowing a safe surgical approach even in

particular situations (15,16). Preoperative imaging diagnosis of possible anatomical variants of the hepatic artery is all the more important in case of patients with concomitant liver disease (17-22).

Conclusions

The common hepatic artery with retroportal route is an extremely rare anatomical variant. If surgeons do not know of its existence, before or during their surgical intervention, this may lead to a significant risk of important vascular lesions, especially of the portal vein, which can greatly complicate the resection time. Route variants of the hepatic artery are particularly important in liver transplantation surgery, interventional radiology, hepato-pancreato-biliary, gastric oncologic surgery, interventional radiology procedures, but also in trauma surgery, especially supramesocolic abdominal penetrating lesions. Ideally, these anatomical variants should be recognized preoperatively so that the most appropriate surgical approach technique can be adopted.

Conflict of Interest Statement

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Statement

The study was conducted respecting the actual ethical principles, with the consent of the health units involved. Informed consent of all patients was obtained and all legal measures were taken to protect personal data. Patients' consent to use the photographs was also obtained.

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