

CASE REPORT

Preserving Left Aberrant Hepatic Artery During Gastrectomy for Cancer – Literature Review and Case Report

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Abstract

Introduction: Identifying left aberrant hepatic artery during gastrectomy for cancer is occasional. In case of replaced left hepatic artery, its ligation can lead to hepatic injury or ischemia, while preserving it can cause difficulties during lymphadenectomy. In literature there is no consensus regarding preserving replaced left hepatic artery during gastrectomy for cancer. A recent study, analysing adverse effects of ligating an aberrant left hepatic artery, shows in patients with over 5 times elevated transaminase levels, increase in hospital length and postoperative complications. On the other hand, there are studies that consider ligation of aberrant left hepatic artery safe, the only inconvenient being postoperative transient elevation of transaminase levels, when ligated artery diameter is over 1.5 mm. **Material and methods:** We report the case of a 65 years old male, known with myocardial infarction, admitted for epigastric pain, nausea, vomiting, dysphagia for solids and important weight loss. Upper gastrointestinal endoscopy with biopsy and computed tomography showed eso-gastric tumoral mass, signet ring cell carcinoma, no metastases. Intraoperative, we found replaced left hepatic artery arising from left gastric artery, close to the celiac trunk, its diameter being approximately 1 cm. Total radical D2 gastrectomy with mechanical eso-jejunal Roux-en-Y anastomosis was performed. Postoperative evolution was favourable surgically, but the patient had SARS-CoV2 infection during hospitalisation. The final pathology report showed 18 lymph nodes examined, 5 being with adenocarcinoma metastases. **Conclusions:** Preserving replaced left hepatic artery during gastrectomy for cancer is preferable, lymphadenectomy not being affected. Potential postoperative complications resulted from ligation of replaced left hepatic artery could have changed the prognosis.

Keywords: artery, hepatic, left, aberrant, gastrectomy, replaced

Rezumat

Introducere. Identificarea unei artere hepatice stângi aberante în timpul gastrectomiei pentru cancer este ocazională. În cazul în care există arteră hepatică stângă de înlocuire, care se divide aproape de origine, ligatura acesteia poate duce la ischemie hepatică, în timp ce prezervarea sa poate genera dificultăți în limfadenectomie. În literatura universală, nu există consens în privința prezervării arterei hepatice stângi de înlocuire în timpul gastrectomiei pentru cancer. Un studiu recent, care analizează efectele adverse ale ligaturii unei artere hepatice stângi aberante constată la pacienții cu creșterea de peste 5 ori a valorilor transaminazelor postoperator, prelungirea duratei de spitalizare și apariția complicațiilor postoperatorii. Pe de altă parte, există studii care consideră sigură ligatura arterei

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hepatice stângi aberante, singurul inconvenient fiind elevarea tranzitorie a valorilor transaminazelor postoperator, în cazul unei artere hepatice stângi cu diametru peste 1.5 mm. **Material și metodă:** Prezentăm cazul unui pacient de 65 de ani, cu antecedente de infarct miocardic, internat pentru dureri epigastrice, vărsături, disfagie pentru solide și scădere ponderală marcată. Paraclinic, endoscopic și tomografic se pune diagnosticul de voluminoasă formațiune tumorală eso-gastrică, fără determinări secundare, biopsia fiind de adenocarcinom îninel cu pecete. Intraoperator se constată variantă anatomică de arteră hepatică stângă de înlocuire voluminoasă, cu diametrul de aproximativ 1 cm, divizată din artera gastrică stângă, aproape de originea din trunchiul celiac. Se practică gastrectomie totală D2 cu esojejunoanastomoză mecanică pe ansă în Y a la Roux (examen histopatologic extemporaneu negativ din tranșa esofagiană). Evoluția postoperatorie este favorabilă chirurgicală, însă grevată de infecție Sars-Cov2. Pe pieșa de rezecție s-au analizat 18 ganglioni, 5 cu metastază de adenocarcinom. **Concluzii:** Prezervarea unei artere hepatice stângi de înlocuire este de preferat în timpul gastrectomiei pentru cancer, aceasta putând fi realizată fără afectarea disecției limfatice. Potențialele complicații postoperatorii rezultate din ligatura arterei hepatice stângi ar fi putut schimba prognosticul.

Cuvinte cheie: arteră, hepatic, stâng, gastroectomie, înlocuire

INTRODUCTION

There has been a long period of debate regarding the optimal surgical treatment of gastric cancer. Japanese guidelines suggesting the adequate type of gastrectomy according with tumour location and Borrmann classification have been globally adopted. Afterwards, randomised trials focused on the lymph node (LN) dissection required for an adequate oncologic procedure and stated that D2 dissection improves disease-specific survival in advanced gastric cancer patients^{1,2,3}. The persistence after fetal maturation, of one or two embryonic hepatic arteries, who usually disappear in the liver vascularisation by a unique hepatic artery originating from the celiac trunk leads to the presence of an anatomical variation. The aberrant left hepatic artery (ALHA) is originating usually from the left gastric artery and runs through the pars condensata of the lesser omentum. The frequency of ALHA is varying from 12 to 34% according to the different study methods: anatomical series (14 to 27%), angiographic studies (12 to 20%) or liver transplantation series (12 to 24%)^{4,5}. An accessory hepatic artery supplies a portion of the liver along with another artery, whilst a replaced hepatic artery supplies a portion of the liver solely.

The first report that the hepatic artery branches often have morphopathological variations is made by Haller in 1756. Almost two hundred years later, in 1966, Michels introduced the classification system that continues to be used worldwide and in 1994, Hiatt modifies Michel's classification (table 1). The two most common variants are: replaced right hepatic artery arising from the superior mesenteric artery and replaced left hepatic artery arising from the left gastric artery^{5,6}.

Whether ALHA originating from left gastric artery should be ligated or preserved during gastrectomy for cancer is a subject under debate, no consensus being stated. Worldwide incidence of ALHA is 13.52%, 8.26% for replaced and 5.55% for accessory type. While preservation of these arteries with complete removal of surrounding lymph nodes could be challenging, especially in laparoscopic surgery, ligation of these arteries is of great concern to surgeons regarding patient's postoperative liver function and safety^{7,8}.

CASE REPORT

We present the case of a 65-year-old male with no oncological family history, with myocardial infarction in 2009, known with arterial hypertension, under treatment, nonsmoker, relatively alcoholic, who was referred to our hospital due to important weight loss, abdominal pain and dysphagia for solids. The patient presented at the clinical exam with an European Cooperative Oncology Group (ECOG) performance status of 1, increased body mass index, afebrile, without skin pallor. Upper gastrointestinal endoscopy revealed vegetate circumferential gastric tumor and the pathology result confirmed the diagnosis of signet ring cell carcinoma. Computed tomography (CT) 48/42mm eso-gastric mass, perigastric lymphadenopathies (16/15mm), no lung or liver metastases. During surgery, variant left hepatic artery arising from left gastric artery, close to the origin from celiac trunk was found, its diameter being of approximately 1cm. the. Total radical D2 gastrectomy with mechanical eso-jejunal Roux-en-Y anastomosis was performed after intraoperative frozen section pathology report confirmed negative resection

Table 1. Hepatic artery variation

Hepatic artery variation	Michels classification	Hiatt classification
Normal anatomy	Type I	Type I
Replaced left hepatic artery originating from the left gastric artery	Type II	Type II
Replaced right hepatic artery originating from the superior mesenteric artery	Type III	Type III
Co-existence of Type II and III	Type IV	Type IV
Accessory left hepatic artery originating from the left gastric artery	Type V	Type II
Accessory right hepatic artery originating from the superior mesenteric artery	Type VI	Type III
Accessory left hepatic artery originating from the left gastric artery and accessory right hepatic artery originating from the superior mesenteric artery	Type VII	Type IV
Accessory left hepatic artery originating from the left gastric artery and replaced right hepatic artery originating from the superior mesenteric artery	Type VIII	Type IV
Common hepatic artery originating from the superior mesenteric artery	Type IX	Type V
Right and left hepatic arteries originating from the left gastric artery	Type X	NOD
Common hepatic artery directly originating from the aorta	NOD	Type VI

margins. Lymphadenectomy was performed preserving the ALHA, which considering its characteristics was probably a replaced left hepatic artery (rLHA). The final pathology report showed 18 lymph nodes examined, 5 being with adenocarcinoma metastases. The postoperative evolution was simple surgically, no transaminase elevation, but the patient had Sars-Cov2 infection during hospitalisation. 2 years follow-up (endoscopy, CT) showed no local recurrence and no distant metastases.

DISCUSSION

Gastric cancer surgery requires complete dissection and removal of lymph node station 7, which can be easily achieved by ligating left gastric artery at its base, including an ALHA, if this is present. During standard gastric cancer surgery, rLHA arising from the left gastric artery is generally underestimated, compared with the replaced right hepatic artery (rRHA). The rLHA is often resected for en bloc lymphadenectomy without vascular reconstruction in gastric cancer surgery despite a reported risk of ischemic liver injury. Many literature studies recommend preservation of ALHA during surgery especially in patients with pre-exist-

ing liver disease to prevent liver dysfunction and ischemia^{9,10,11}.

Shinohara et al. reported no difference in oncologic outcome between patients whose ALHA were preserved or ligated during gastric cancer surgery and preserving ALHA during surgery increases the operation time and blood loss especially during laparoscopic procedures¹². ALHA is rarely seen during laparoscopic gastrectomy for cancer, but current evidence shows that laparoscopic gastrectomy has similar or even better outcome compared to open gastrectomy and is safe even in patients with chronic liver disease^{13,14,15}.

In a recent study, of the 2,487 patients who had laparoscopic gastrectomy for gastric cancer at Seoul National University Hospital, 204 patients with ALHA were selected for analysis. 131 (64.2%) were classified as replaced and 73 (35.8%) as accessory left hepatic artery and arteries were preserved in 135 (66.2%) cases and ligated in 69 (33.8%) cases. Results showed after ligation of rLHA or accessory left hepatic artery (acLHA) only transient elevation in SGOT and SGPT levels which spontaneously returned to normal two weeks after surgery (ALHA >1.5mm). There were no reports of hepatic necrosis even after ligation of ALHA in patients with preexisting liver disease. The limitations of

this study consist in a small number of patients and a single centre experience⁷.

Mays et al. and Lee et al. have demonstrated in their studies that revascularization through collateral flow takes place after ligation of hepatic arterial inflow. In literature, there were case reports of ligation of ALHA, proper hepatic artery for ruptured aneurysm and even accidental ligation of hepatic artery which showed no morbidity and mortality^{16,17,18,19,20}.

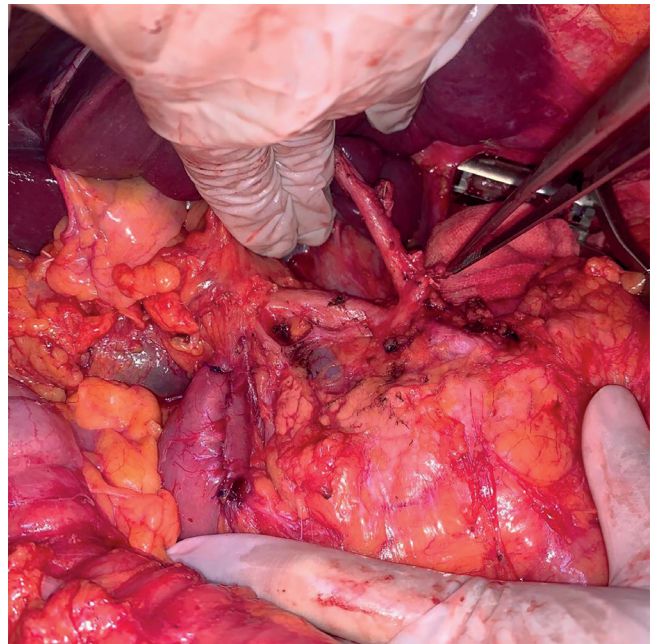
In contrast, other studies have reported severe complications such as abscess formation, cholangitis, liver failure, liver necrosis and even deaths after ligation of ALHA. Among patients with a ligated ALHA, those with peak AST/ALT ≥ 5 times the normal showed worse perioperative outcomes in terms of hospital stay and severity of complications^{12,21}. The major consequence of ALHA ligation is transient hepatic dysfunction, but in patients with chronic liver disease, who are less tolerant to liver injury, ligation could lead to fatal liver failure.

In another study, Kim et al analysed 1,340 patients with early gastric cancer who underwent laparoscopic distal gastrectomy. 150 patients had ALHA, in 116 cases it was ligated and in 34 preserved. The results suggested to preserve the ALHA arising from a large LGA, having diameter greater than 5 mm, during laparoscopic gastrectomy, to prevent immediate postoperative hepatic dysfunction²². Oki et al.⁴ have even suggested the ALHA be preserved whenever it is encountered during laparoscopic gastrectomy²³.

Previous studies have suggested conducting preoperative evaluation using three-dimensional computed tomography angiography before gastrectomy to assess vascular anatomy. The detection rate of ALHAs was lower than the incidence previously reported. Differentiating between replaced and accessory ALHAs would be even more difficult using angiography^{24,25,26,27}.

Generally, it is thought that ligation of a large ALHA would result in postoperative hepatic dysfunction. Even though the evidence for this is weak and there is no consensus, lethal complications, including left hepatic lobe necrosis, after ligation of the rLHAs have been reported in the literature^{28,29}.

The case presented showed good results after preserving rLHA and no inconvenience in performing correct lymphadenectomy. The postoperative evolution showed no surgical complications and 2 years follow up with no local or distant relapse. Considering the patients medical history and the SarsCov2 infections



Replaced left hepatic artery found in total gastrectomy for cancer.

during hospitalisation, the ligation of rLHA could have changed the prognosis.

In literature there are still lots of debates on whether it is safe to ligate aberrant left hepatic artery during abdominal surgeries. Replaced ALHAs should be preserved to avoid postoperative hepatic dysfunction. Studies have shown that some accessory ALHAs are the only supplying vessel to a specific territory of the liver, which suggests that they should be preserved same as replacing arteries. Therefore, ligation of either replaced or accessory ALHAs could result in postoperative hepatic dysfunction.

Statement of ethics.

All procedures followed have been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. Written informed consent for publishing this case, including images, was obtained from the patient.

Conflict of interest Statement

The authors have no conflict of interest to declare.

Funding Sources

There are no financial conflicts of interest to disclose.

References

1. Japanese Gastric Cancer Association. Japanese Gastric Cancer Treatment Guidelines 2021 (6th edition). *Gastric Cancer* 26, 1-25(2023).
2. M. Degiuli, R. Reddavid, M. Tomatis, A. Ponti, M. Morino, M. Sasako. D2 dissection improves disease-specific survival in advanced gastric cancer patients: 15-year follow-up results of the Italian Gastric Cancer Study Group D1 versus D2 randomised controlled trial. *European Journal of Cancer*, volume 150, June 2021, p. 10-22.
3. I. Songun et al. Surgical treatment of gastric cancer: 15-year follow-up results of the randomised nationwide Dutch D1D2 trial. *Lancet Oncol* (2010).
4. Abid B, Douard R, Chevallier JM, Delmas V. L'artère hépatique gauche, variations anatomiques et implications cliniques [Left hepatic artery: anatomical variations and clinical implications]. *Morphologie*. 2008 Dec;92(299):154-61.
5. George Nossios, Ioannis Dimitriou, Iosif Chatzis, Anastasios Katsourakisb. The Main Anatomic Variations of the Hepatic Artery and Their Importance in Surgical Practice: Review of the Literature. *J Clin Med Res*. 2017 Apr; 9(4): 248–252.
6. Hiatt JR, Gabbay J, Busuttil RW. Surgical anatomy of the hepatic arteries in 1000 cases. *Ann Surg*. 1994;220(1):50–52.
7. Rene Ronson G. Ang, Hyuk-Joon Lee, Jae Seok Bae, Chun-Chao Zhu, Felix Berth, Tae Han Kim, Shin-Hoo Park, Yun-Suhk Suh, Seong-Ho Kong, Se Hyung Kim, Han-Kwang Yang. Safety of Ligation of Aberrant Left Hepatic Artery Originating from Left Gastric Artery in Laparoscopic Gastrectomy for Gastric Cancer. *Sci Rep*. 2020; 10: 5856.
8. Cirocchi, R et al. Aberrant left hepatic arteries arising from left gastric arteries and their clinical importance. *The Surgeon*. (19)30077-0, S1479-666X. 10.1016/j.surge.2019.06.002 (2019).
9. Japanese Gastric Cancer Association Japanese classification of gastric carcinoma: 3rd English edition. *Gastric Cancer*. 2011;14:101–112.
10. Huang CM, et al. Short-term clinical implications of the accessory left hepatic artery in patients undergoing radical gastrectomy for gastric cancer. *PLoS One*. 2013;8(5):e64300. doi: 10.1371/journal.pone.0064300.
11. Hendrickson, R. J. et al. Preservation of an aberrant left hepatic artery during laparoscopic nissen fundoplication. *JLSLS*. 10(2), 180–3 (2006).
12. Shinohara, T., Ohyama, S., Muto, T., Yanaga, K., Yamaguchi, T. The significance of the aberrant left hepatic artery arising from the left gastric artery at curative gastrectomy for gastric cancer. *Eur. J. Surg. Oncol*. 33, 967–971, <https://doi.org/10.1016/j.ejso.2007.02.030> (2007).
13. Kim W, et al. Decreased morbidity of laparoscopic distal gastrectomy compared with open distal gastrectomy for stage I gastric cancer: short-term outcomes from a multicenter randomized controlled trial (KLASS-01) *Ann. Surg*. 2016;263(1):28–35.
14. Lee HJ, Yang HK. Laparoscopic gastrectomy for gastric cancer. *Dig. Surg*. 2013;30(2):132–41. doi: 10.1159/000350884.
15. Yoon HM, et al. Comparison of liver function after laparoscopically assisted and open distal gastrectomies for patients with liver disease. *Surg. Endosc*. 2011;25(6):1761–5.
16. Mays, E. T. & Wheeler, C. S. Demonstration of collateral arterial flow after interruption of hepatic arteries in man. *N. Engl. J. Med*. 290, 993–996 (1974).
17. Lee, S. W. et al. Preoperative simulation of vascular anatomy by three-dimensional computed tomography imaging in laparoscopic gastric cancer surgery. *J. Am. Coll. Surg*. 197, 927–36 (2003).
18. Chirica, M. et al. Hepatic artery ligation: a simple and safe technique to treat extrahepatic aneurysms of the hepatic artery. *Am. J. Surg*. 196(3), 333–8, <https://doi.org/10.1016/j.amjsurg.2007.08.074>. (2008). Epub 2008 Jun 30.
19. Brittain, R. S., Marchioro, T. L., Hermann, G., Waddell, W. R. & Starzl, T. E. Accidental hepatic artery ligation in humans. *Am. J. Surg*. 107, 822–832 (1964).
20. Egorov, V. et al. Celiaco-mesenterial arterial aberrations in patients undergoing extended pancreatic resections: correlation of CT angiography with findings at surgery. *JOP*. 11(4), 348–357 (2010).
21. Huang, C. M. et al. Short-term clinical implications of the accessory left hepatic artery in patients undergoing radical gastrectomy for gastric cancer. *PLoS One*. 8(5), e64300, <https://doi.org/10.1371/journal.pone.0064300> (2013).
22. Jieun Kim, Su Mi Kim, Jeong Eun Seo, Man Ho Ha, Ji Yeong An, Min Gew Choi, Jun Ho Lee, Jae Moon Bae, Sung Kim, Woo Kyoung Jeong, Tae Sung Sohn. Should an Aberrant Left Hepatic Artery Arising from the Left Gastric Artery Be Preserved during Laparoscopic Gastrectomy for Early Gastric Cancer Treatment? *J Gastric Cancer*. 2016 Jun; 16(2): 72–77.
23. Oki E, Sakaguchi Y, Hiroshige S, Kusumoto T, Kakeji Y, Maehara Y. Preservation of an aberrant hepatic artery arising from the left gastric artery during laparoscopic gastrectomy for gastric cancer. *J Am Coll Surg*. 2011;212:e25–e27.
24. Matsuki M, Kani H, Tatsugami F, Yoshikawa S, Narabayashi I, Lee SW, et al. Preoperative assessment of vascular anatomy around the stomach by 3D imaging using MDCT before laparoscopy-assisted gastrectomy. *AJR Am J Roentgenol*. 2004;183:145–151.
25. Lee SW, Shinohara H, Matsuki M, Okuda J, Nomura E, Mabuchi H, et al. Preoperative simulation of vascular anatomy by three-dimensional computed tomography imaging in laparoscopic gastric cancer surgery. *J Am Coll Surg*. 2003;197:927–93.
26. Yamashita K, Sakuramoto S, Mieno H, Shibata T, Nemoto M, Katada N, et al. Preoperative dual-phase 3D CT angiography assessment of the right hepatic artery before gastrectomy. *Surg Today*. 2014;44:1912–1919.
27. Koops A, Wojciechowski B, Broering DC, Adam G, Krupski-Berdiën G. Anatomic variations of the hepatic arteries in 604 selective celiac and superior mesenteric angiographies. *Surg Radiol Anat*. 2004;26:239–244.
28. Lurie AS. The significance of the variant left accessory hepatic artery in surgery for proximal gastric cancer. *Arch Surg*. 1987;122:725–728.
29. Hemming AW, Finley RJ, Evans KG, Nelems B, Fradet G. Esophagogastrectomy and the variant left hepatic artery. *Ann Thorac Surg*. 1992;54:166–168.