

Accessory Hepatic Artery Arising from Celiac Trunk: An Incidence in a Thai Cadaver

Arteria Hepática Accesoria Derivada del Tronco Celiaco: Hallazgo en un Cadaver Tailandés

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SUMMARY: An exhaustive knowledge of the liver vascular patterns as well as possible anatomical variations is significant in the planning and performance of all liver surgical procedures in order for the vascularity not to be disturbed or not causing necrosis of the liver parenchyma postoperatively. The celiac trunk usually provides three branches; left gastric, splenic and common hepatic arteries. The left and right hepatic arteries generally derive from proper hepatic artery which is a branch of common hepatic artery. To study the incidence of celiac trunk ramification, the branching patterns of the celiac trunk of 23 Thai cadavers (17 males, 6 females) were documented during routine dissection by medical students at the Department of Anatomy, Faculty of Medical Science, Naresuan University, Thailand. The clinically important variations of the celiac trunk were noted. The results showed that all celiac trunks arose from each aortas at the T12 vertebra (17.39%, 4 cases), intervertebral disc between T12 and L1 vertebra (78.26%, 18 cases) and upper 1/3rd of L1 vertebra (4.35%, 1 case). We found 95.65% (22 cases) normal celiac trunk trifurcation; whereas, 4.35% (1 case) was abnormal quadrifurcation of the trunk. The accessory hepatic artery (aHA) was presented as an additional branch of celiac trunk because the conventional pattern of the left and right hepatic arteries was presented. This finding is one of the rare anatomical variations which is reported in available literatures. The awareness of celiac trunk and its stems aberrant is important in procedures such as liver transplant for appropriate vascular ligation and anastomosis.

KEY WORDS: Accessory hepatic artery; Celiac trunk; Thai cadaver.

INTRODUCTION

Based on the worldwide-accepted anatomical text books (Gray's Anatomy), the celiac trunk gives rise to the largest splenic artery originating from the midline of the anterior aspect of the celiac trunk, the common hepatic artery arising from the right side of the celiac trunk and the smallest left gastric artery branching from the left aspect of the trunk. In general, the liver receives the arterial supply from the proper hepatic artery derived from the common hepatic artery. The proper hepatic artery terminates at the hilum of liver before further divides into the main left and right hepatic arteries supplying the whole liver. There are commonly two types of hepatic artery variations, namely the accessory and the replaced hepatic arteries. The accessory hepatic artery (aHA) is referred to as an arterial vessel that supplies hepatic lobule in addition to the normal supply; whereas, the replaced hepatic artery means an artery that does not originate from an orthodox position and is the only supply to a particular hepatic lobule (Standring *et al.*, 2008). An accessory or

replaced right hepatic artery is commonly reported to branch from the superior mesenteric artery, despite an accessory or replaced left hepatic arteries is often originated from the left gastric artery (Michels, 1966; Standring *et al.*; Chen *et al.*, 2009). In rare cases, these variant arteries emerge from gastroduodenal artery, the celiac trunk, or the abdominal aorta (Michels; Standring *et al.*).

Liver transplantation is an ultimate treatment for patients with end-stage liver disease. Vascular complications after liver transplantation are often associated with poor outcomes for both the grafts and patients (Tzakis, 1985). The anatomical variation of hepatic artery in the liver transplanted recipients increased the risk of hepatic artery complications after transplantation (Ishigami *et al.*, 2004). The variation of celiac axis and common hepatic artery had been studied in 5002 Korean patients. The authors had reported that the anatomical variation of hepatic artery (HA)

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originating from the celiac trunk was seen in 9.6% (428/5002) of cases (Song *et al.*, 2010). In Thailand, the HA variation was a study in 200 patients by 3-D reconstruction MDCT Scan. The research team found that there were 5 cases in which the new variation types were reported in so-called Siriraj types (Prabhasavat & Homgagae, 2008). Among these types, there was the right aHA variation which originated from superior mesenteric and celiac arteries included. Moreover, the study in Indian cadavers found that there was the aHA variation divided from celiac axis in approximately 5% of the cases. Anatomical variations of hepatic arterial supply can significantly alter the surgical management of the liver transplant surgeries. Hence, the anomaly of the branches must be comprehended.

MATERIAL AND METHOD

During a routine educational dissection course for medical students at the Department of Anatomy, Faculty of Medical Science, Naresuan University, Thailand. All cadavers were obtained from body donation with informed consent, and signed by the donator themselves. The branching patterns of celiac trunk in 23 cadavers of both sexes (17 males, 6 females), aged between 38-93 years old were investigated and analyzed. The abdominal cavities, retroperitoneal space and the celiac trunk have been dissected and identified by medical students under supervision and confirmed by department's lecturer. Further dissection and branching pattern analysis as well as the vertebral level of origin of the celiac trunk were performed by the authors.

RESULTS

The celiac trunk in all cadavers was constricted at the site of origin from the abdominal aorta. It rose from the aorta at the level of T12 vertebra in 4 cases (17.39%), intervertebral disc between T12 and L1 vertebra in 18 cases (78.26%), and upper 1/3rd of L1 vertebra in 1 case (4.35%). On the descending aorta, the distance between the site of origin of celiac trunk and superior mesenteric arteries varied from 4 to 10 mm.

The trifurcation of the celiac trunk into usual three branches: the left gastric artery, common hepatic artery, and splenic artery, was observed in 22 cadavers (95.65%) in the present study (Fig. 1A). Among these three branches, the splenic artery was the largest branch of celiac trunk; whereas, the left gastric was the first and smallest branch of celiac trunk in all cases. Except one formaline-embalmed cadaver

of a 46-year-old-man (4.35%), the aberrant celiac trunk branching was identified. In this case, the celiac trunk was originating from the anterior wall of the abdominal aorta at T12 vertebral level, 4 mm proximal to the superior mesenteric artery. The celiac trunk was presented with four branches, three normal branches and one smallest aHA (Fig. 1B). This aHA was dividing from the trunk as the first branch and was originating just close to the base of celiac trunk beside the common hepatic artery. Moreover, it was originating with a distance of approximately 120 mm from

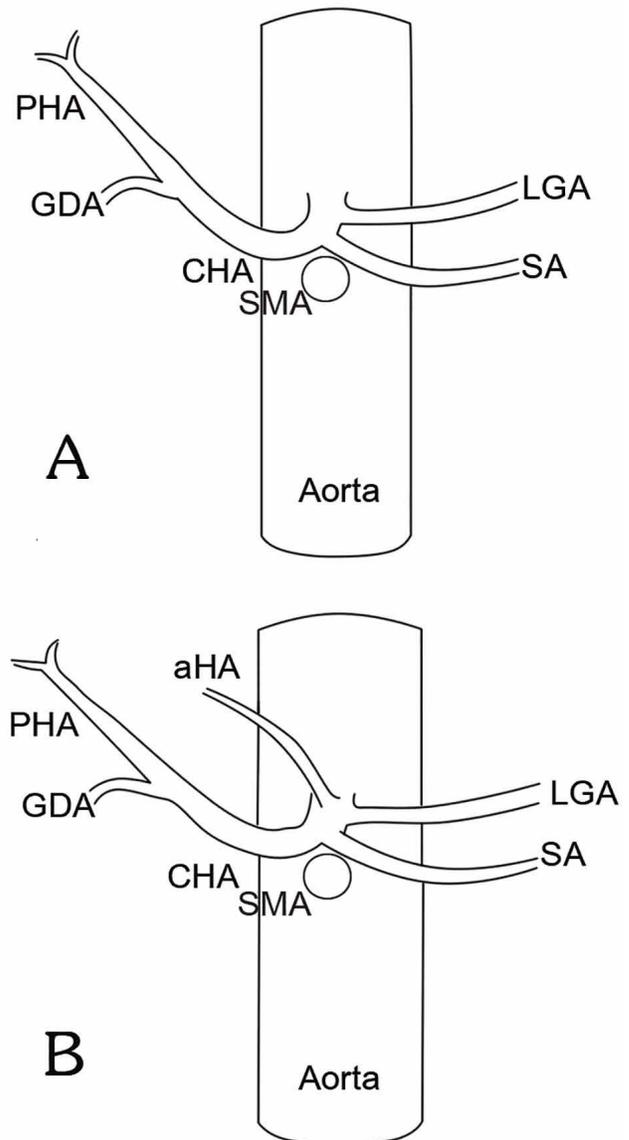


Fig. 1. A. Schematic diagram showing the three usual branches: the left gastric artery (LGA), common hepatic artery (CHA) and splenic artery (SA) of celiac trunk. B. Schematic diagram showing the unusual small accessory hepatic artery (aHA) originated just close to the base of celiac trunk and beside the common hepatic artery. GDA= gastroduodenal artery, PHA= proper hepatic artery, SMA= superior mesenteric artery.

the origin of the celiac trunk to the liver. After branched, this typical artery reached the liver by entering the fissure for ligamentum venosum and had no branch along its distance. In all cases, the proper hepatic artery was observed and found that it terminated near the left end of the hilum of the liver and was dividing into the expected branches: the right and left hepatic arteries as usual patterns.

DISCUSSION

In this study, we first found an additional aHA originating from the left aspect of celiac trunk entering the hilum of liver in a Thai cadaver. It appeared as the first branch of the celiac trunk and originated close to the base of the celiac trunk and also near the common hepatic artery. We classified this aHA as an additional artery supplying the liver because of the presence of a normal hepatic artery. According to the reviewed literatures, the incidence of this aHA was a less variation comparing with other variant types (Michels; Hiatt, 1994; Gruttadauria *et al.*, 2001; Bhardwaj, 2010). This study shows that there is additional aHA branch arises as the first stem from the base of celiac trunk. Previous study in 200 Thai patients by abdominal MDCT scanning, new variation patterns of accessory right hepatic artery were found in 5 patients and classified as Siriraj types. These new types were identified as accessory right hepatic artery from hepatic artery proper, common trunk of superior mesenteric, celiac artery and left gastric artery (Prabhasavat & Homgage). According to our result, we suggest this aHA variation type is a subset of Siriraj types and its pattern is similar to the previous study in Indian cadavers (Dutta & Mukerjee, 2010). Moreover, the prevalence of this present aHA type was about 4.35% which is almost similar to the only recently study in 84 Indian male cadavers which reported that there was 5% variant of aHA (Dutta & Mukerjee).

An anomalous branching pattern is often due to an original development during embryonic life. At the beginning, the dorsal aorta branches into the 10th to 13th splanchnic or vitelline arterial roots before its fusion. After the fusion, many of these arteries degenerate and later the celiac trunk and the superior and inferior mesenteric arteries develop and are present in adult. In general, the embryonic left hepatic artery, the middle hepatic artery and the right hepatic artery originate respectively from the left gastric artery, the celiac axis and the superior mesenteric artery. After that, the embryonic left hepatic and right hepatic arteries regress while the middle hepatic artery remains as the proper hepatic artery supplying the whole liver as shown in adult. In the case where failures in the regression of these

embryonic arteries occur may lead to abnormal branching pattern of hepatic arteries. Furthermore, the branching variations of celiac trunk are usually caused by the remaining ventral splanchnic branches of the dorsal aorta (Rejendran *et al.*, 2011). According to previous information, an appearance of additional right hepatic artery originates from the superior mesenteric artery, and an additional left hepatic artery is branched from the left gastric artery (Panagouli & Venieratos, 2011; Rejendran *et al.*). There are many arterial variant patterns commonly reported in various studies and this information is necessary for clinical applications (Nelson *et al.*, 1988; Jones & Hardy, 2001). The arterial variation in this case report may throw light on the possible variation of accessory hepatic artery. Preoperative knowledge of the variations of the hepatic artery is essential for surgeons.

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RESUMEN: Un conocimiento exhaustivo de los patrones vasculares del hígado, así como sus posibles variaciones anatómicas son importantes en la planificación y realización de todos los procedimientos quirúrgicos hepáticos para evitar comprometer la vascularización y posible necrosis del parénquima después de la cirugía. El tronco celíaco, por lo general, proporciona tres ramas: gástrica izquierda, esplénica y arteria hepática común. Las arterias hepáticas izquierda y derecha en general derivan de la arteria hepática propia, que es una rama de la arteria hepática común. El objetivo de este trabajo fue estudiar la incidencia de distribución del tronco celíaco mediante la documentación de patrones de ramificación en 23 cadáveres de Tailandia (17 hombres y 6 mujeres). El estudio se efectuó durante la disección de rutina realizada por los estudiantes de medicina en el Departamento de Anatomía de la Facultad de Ciencias Médicas, Universidad de Naresuan, Tailandia. Se observaron las variaciones clínicamente importantes del tronco celíaco. Los resultados mostraron que todos los troncos celíacos surgieron desde la aorta a nivel de la vértebra T12 (17,39%, 4 casos), a nivel del disco intervertebral entre T12 y L1 vértebra (78,26%, 18 casos) y a nivel del tercio superior de la vértebra L1 (4,35%, 1 caso). Encontramos un 95,65% (22 casos) de troncos celíacos normales, es decir, con trifurcación; mientras que un 4,35% (1 caso) era anormal, con 4 ramos terminales. La arteria hepática accesoria (AHA) se presentó como una rama accesoria del tronco

celíaco, ya que existía un patrón convencional de las arterias hepáticas izquierda y derecha. Este hallazgo representa una de las raras variaciones anatómicas informada en la literatura. El conocimiento del tronco celíaco y sus ramas aberrantes son importantes en procedimientos como el trasplante hepático, la anastomosis y una ligadura vascular adecuada.

PALABRAS CLAVE: Arteria hepática accesoria; Tronco celiaco; Cadáver tailandés.

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