Case report

Quadruple arterial blood supply to the liver: A rare variation

Abstract

Introduction: Vascular variations in the liver are significant to surgeons in liver transplantations, radiological procedures, laparoscopyand penetrating abdominal injuries. These variations are important in liver transplantation procedure, in addition to being an ideal opportunity for surgical anatomy study, their detailed identification is crucial to the success of the procedure.

Case Report: During a routine dissection of the abdomen for medical students at the department of Anatomy UsmanuDanfodiyo University, Sokoto. A male adult cadaver with unknown identity and cause of death, we found four arterial branches to the liver, one each from the left gastric artery and common hepatic artery, a branch from the gastro-duodenal artery and the hepatic artery.

Conclusion: Detailed knowledge of the variations of hepatic arterial anatomy is of utmost importance to surgeons who perform surgeries in this area, particularly in liver transplantation, since their identification and proper management are critical to the success of the procedure.

Key words: Quadriple, arterial, blood supply, liver, variation

Introduction

liver and other abdominal organs blood supply play a very important role during abdominal surgeries. Information about the common patterns of vascular supply should be increased and new anomalies of the celiac trunk and other arteries around it are poorly reported.Vascular variations in the liver are significant to surgeons, in radiological procedures, liver transplantations, laparoscopyand penetrating injuries to the abdomen around the liver[1-3]. These variations are important in liver transplantation procedure, in addition to being an ideal opportunity for surgical anatomy study, their detailed identification is vital to the success of a surgical procedure[4,5].

The classical arterial supply to the liver is only found in 50-80% of cases. Several classifications attempt to define andsort these variations, the most commonly used being Hiatt/Michels'[6]. Early identification of arterial variations canprevent vascular damage during harvesting and back tablesurgery that could lead to postoperative complications.There are few published series focusing on donor hepaticarterial variations.This information is crucial when conducting hepatic or pancreatic surgery as injuring to an aberrant hepatic artery can deeply affect the postoperative outcome of the patient[7].

In 55%-75% of the individuals, the normal hepatic arterial supply consists common hepatic artery arising from the celiac trunk, which becomes hepatic artery proper after the origin of

the gastroduodenal artery, the hepatic artery proper give rise to a right (RHA) and a left hepatic artery (LHA), which supply the right and left lobes of the liver respectively[8]. The presence of hepatic artery variations should always be preoperatively assessed as this information can condition the possibility to perform a radical liver tumor resection with negative margins and/or be responsible for life-threatening postoperative complications. Vascular anatomy is generally evaluated through contrast-enhanced computed tomography which guarantees elevated sensitivity and specificity [9].

In this case report, we present A male adult cadaver, with four arterial branches to the liver. from the Department of Anatomy, Faculty of Basic Medical Sciences of the UsmanuDanfodiyo University, Sokoto, Nigeria. The aim of this report is increase awareness of this anatomical variation, and to demonstrate the presence of this form of variation among our population.

Case report

During a routine dissection of the abdomen for medical students at the department of Anatomy UsmanuDanfodiyo University, Sokoto. A male adult cadaver with unknown identity and cause of death.We found an unusual multiple arterial supply to the liver. The left gastric artery gave a branch to the liver (the 1st branch to the liver in fig 1). A separate branch to the liver was given off by the common hepatic artery (the 2nd branch to the liver in fig 1).The hepatic artery enters the liver as a single artery, without dividing into a right and left hepatic arteries (the 3rd branch to the liver in fig 1).The gastro-duodenal artery after branching off from the common hepatic artery, also gave a branch to the liver (the 4th branch to the liver in fig 1).

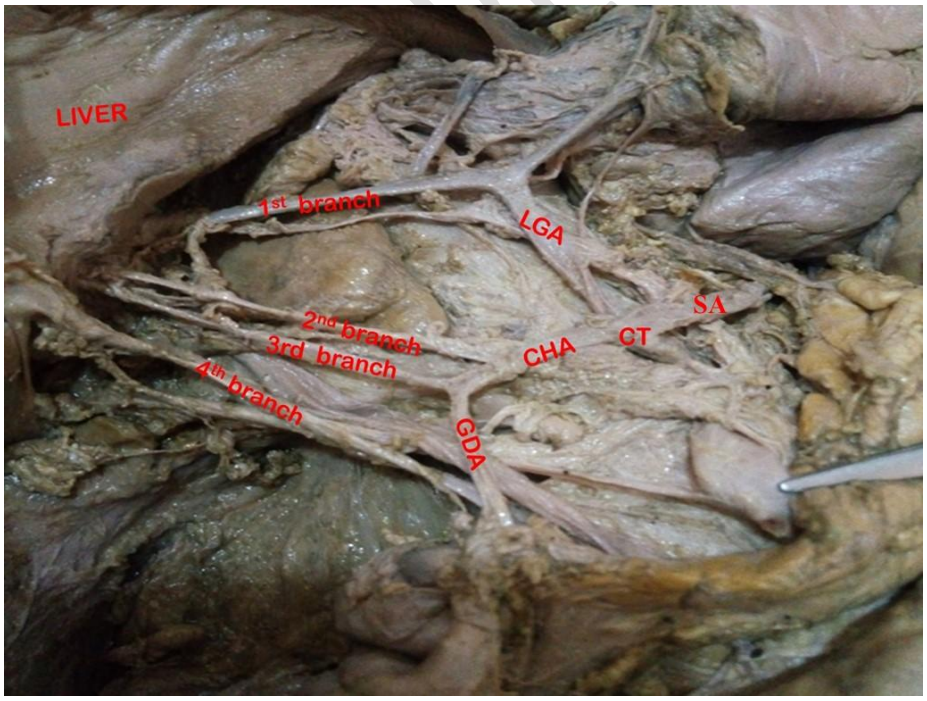

Figure 1. Image of the dissected abdomen showing four different arteries to the liver and other arteries from the celiac trunk (CT). **LGA:** Left gastric artery, **SA:**Splenic artery, **CHA:** Common hepatic artery, **GDA:**

Gastroduodenal artery,**1st branch** from left gastric artery, **2nd branch** from Common hepatic artery, **3rd branch** is the hepatic artery proper, **4th branch** fromgastroduodenal artery.

Essentially there were four arterial branches to the liver. The left lobe of the liver was essentially supplied by 1st and 2nd branches from left gastric and common hepatic arteries respectively. The right lobe of the liver was essentially supplied by 3rd branch, which is the hepatic artery proper and 4th branches fromgastroduodenal artery.No other arterial anomaly was observed in the region

Discussion

Anatomically, the celiac trunk is the first artery to originate anteriorly from the abdominal aorta at the level of T12. It splits into 3 branches: the left gastric artery, the splenic artery, and the common hepatic artery. The celiac trunk is the artery of the foregut, itsupplies to the liver, gallbladder, spleen, pancreas, and gut from the distal esophagus to the ampullar of vater[6,8].

Embryologically, the celiac trunk develops from six pairs of ventral splanchnic vessels (subphrenic, upper, middle, lower ventricular and upper and lower intestinal). During intrauterine development, these pairs disappear following vascular extensions and branching.However, the persistence of longitudinal channels between primitive vessels may lead to vascular anomalies or variations in this region[11]. Variations in blood supply to the liver has been described by many authors[1,12,13,14].However, we are yet to find report on the quadrupled arterial supply from the branches of coeliac artery except the splenic artery. Galen was the first anatomist who researched the arterial system from the celiac trunk and observed the arteries leading to the liver, stomach and spleen. Later on, Andreas Vesalius gave anatomical descriptions of the Galen's discoveries in the sixteenth century[6]. On the basis of Hiatt's classification, the most common hepatic artery variation was accessory or replaced left hepatic artery, this is not the case in the cadaver dissected by our group[2].

The presence of an accessory right hepatic artery (aRHA) or a replaced right hepatic artery (rRHA) does not seem to impact on postoperative outcomes, and should not be considered as a contraindication to minimal invasive surgery approach when planning for pancreaticoduodenectomy (PD) [13,28]. However, as found in this study, the surgeon should have in mind the possibility of a conversion to laparotomy because of a branch to the liver that is coming from the pancreaticoduodenal artery, which may expose the patient to the risk of vascular injuries. Variant arterial anatomy is common, occurring in nearly half of the population[14]. However, 4 arteries from different origin supplying the liver have not been reported. In cases where a liver transplant is planned, or when a surgical management of patients with pancreatic and hepato-biliary neoplasms is arranged, recognition of these vascular anomalies may significantly affect the surgical approach.

The anatomical variations in the coeliac trunk and hepatic arterial system were evaluated with multidetector CT (MDCT) angiography among 100 patients. Normal anatomy was reported in 50% of the patients. The remaining 50% were reported to have either coeliac trunk or hepatic artery variation[7]. None of the patients in this 50% have the type of variation found in our report. Liver segment IV is of critical importance in transplant surgery. For that reason,

it is important to know the origin of its blood supply. In an MDCT study conducted by Kamel et al, the segment IV artery was reported to originate from the right hepatic artery in 62.5% of cases[15]. In our study, the segment IV artery will most likely originate from the 4th branch to the liver which is coming from the gastroduodenal artery.

A normal hepatic arterial system has been reported in 51–80% of cases in most studies conducted using Digital subtraction angiographyDSA[16,17].In the literature, the most frequently encountered variation is Type III, present in between 6% and 15.5% of all cases[18,19]. The second most frequent variation, Type II, was reported in 2.5–10% of all cases[20-22]. The findings of our study are not reported in any of these studies. This report highlights the significance and relevance of the traditional cadaver dissection to the training of medical and allied students, in spite of its challenges and drawbacks [23]. In spite of the growing advocacy for virtual dissection in anatomy education, cadaver dissection remains the gold standard for anatomical studies, as stated by the International Federation of Associations of Anatomists (IFAA) [24]. This is because, students acquirethe skills and relate to structural relationships, and also see anatomic variations of significant surgical and medical relevance, that widens the coverage of medical knowledge, and improves their confidence, competence, mastery, interpersonal communication skills, mental and emotional development [25-27].

Conclusions

These arterial patterns are critical to the planning and precise preoperative evaluation for all surgical and radiological procedures in the upper abdomen. This informationgoes beyond simple academic knowledge, they profoundly influence practice and success of the procedures depends on them. Surgeonsshould be aware of all potential variations around the liver to avoid complications postoperatively.

Disclosure of interest

The authors declare that they have no competing interest.

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