'Y' shaped gallbladder associated with accessory cystic and hepatic arteries

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SUMMARY

We found variations in the gallbladder, hepatic artery, and cystic artery in an embalmed male cadaver in which all were noted double. Both the gallbladders had separate fundus, neck, and body, but their ducts were short and fused to form a single cystic duct. According to the literature, this pattern falls under 'Y-shaped' gall bladder. After opening the gallbladders, there were no gallstones found. It was noted that the accessory hepatic artery was also a content of the Calot's triangle. This accessory hepatic artery was branching from the coeliac artery. The accessory cystic artery was branching from the accessory right hepatic artery. The anatomical details of the hepatic artery variations are significant because, during upper abdominal surgeries, it is important to preserve the hepatic arterial supply. In laparoscopic surgeries, the knowledge of variations of the gallbladder and cystic artery is essential to prevent their iatrogenic complications, such as arterial damage and biliary tract injury. The radiologists also need to have knowledge about duplication of the gall bladder, cystic and hepatic arteries to avoid misinterpretation.

Key words: Cholecystitis – Cystic Duct – Gallbladder – Hepatic Artery

INTRODUCTION

Knowledge of variations of the gallbladder (GB) and its arterial supply is essential to laparoscopic surgeons. Double GB is an infrequent inborn anomaly, seen in 1 among 4000 live births (Boyden, 1926). If the double GB is not diagnosed beforesurgery, it could be hard for the operating surgeon to find out the exact position of the second GB (Puneet et al., 2006). Congenital malformation of the GB and its topographical variations have a greater risk of intraoperative complications, like injury to the biliary ducts during laparoscopy (Badagabettu et al., 2016). In biliary laparoscopic surgery, knowledge of the variation of cystic artery and GB are very important. It was reported

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that the anatomical variations of GB could hinder the biliary outflow, which leads to biliary stasis. The anatomical variants of GB cause inflammation of the gall bladder, which is known as cholecystitis, and also the formation of gall stones, cholelithiasis. Failure to detect an accessory GB will affect the prognosis of a case of cholecystitis. This may result in repeated attacks of symptoms of cholecystitis (Nayak et al., 2014). Preoperative diagnosis of double GB can be done by using ultrasound abdomen, computed tomogram scan, oral cholecystogram, endoscopic retrograde cholangio pancraetogram, magnetic resonance imaging scan, and scintigraphy (Puneet et al., 2006). However, the morphological variants of GB can cause diagnostic dilemmas to the radiologist and laparoscopic surgeons (Nayak et al., 2018). Gorecki et al. (1998) had an experience of a double GB, which was identified only during a laparoscopy. In this case, they shifted from laparoscopic surgery to laparotomy to avoid complications.

The hepatic artery should not be injured in case of abdominal surgeries to avoid hepatic ischemic complications. To achieve this, the knowledge of the variant origin and branching of the hepatic artery is important. The origin of the cystic artery is often variable, and information about accessory cystic artery and variant origin of it is important in laparoscopic surgery. In this case, we report duplication of the GB, which was associated with accessory hepatic and cystic arteries, which were observed in an anatomical specimen.

CASE REPORT

In a routine dissection performed to teach medical students, it was found that the variations were obvious in the extrahepatic biliary apparatus. This was in a 60-year-old well-built and nourished male cadaver in whom the GB, hepatic artery, and cystic artery were noted double (Fig. 1). The 'Y-shaped' gallbladder associated with accessory cystic and hepatic arteries in this study is schematically represented in Fig. 2. Both the GBs were having separate fundus, neck, and body (Fig. 1), but their ducts were short and fused to form a single cystic duct (Fig. 3). The GB's were located in the single GB fossa. After opening both the GBs,

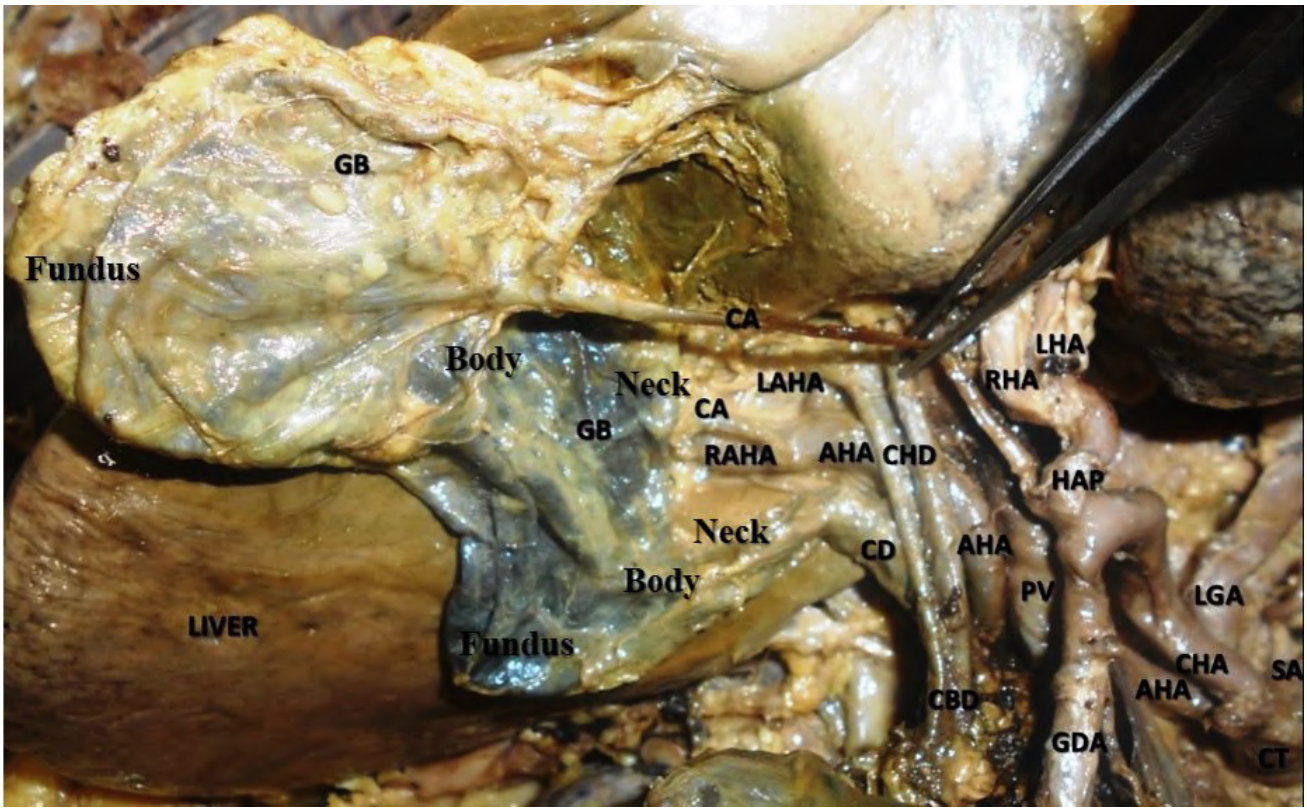

Fig. 1.- Cadaver showing double gallbladder (Y-shaped), double cystic artery and double hepatic artery. The fundus, body and neck of both the gall bladders are also visible (AHA-accessory hepatic artery, CA-cystic artery, CD-cystic duct, CBD-common bile duct, CHA-common hepatic artery, CHD-common hepatic duct, CT-coeliac trunk, GB- gall bladder, GDA-gastroduodenal artery, HAP-hepatic artery proper, LHA-left hepatic artery, LAHA-left accessory hepatic artery, LGA-left gastric artery, PV-portal vein, RHA-right hepatic artery, RAHA-right accessory hepatic artery, SA-splenic artery).

there were no gallstones found (Fig. 4) in the interior of both the gall bladders.

It was noted that the accessory hepatic artery (AHA) was an additional content of the triangle of Calot (Fig. 3). This AHA arose as an extra branch from the coeliac trunk. AHA was observed on the right side of the portal vein and left to the common bile duct (Fig. 1). AHA gave two branches as right accessory hepatic artery (RAHA) and left accessory hepatic artery (LAHA). The common hepatic artery was found normal in its origin and course. Then, it divided into the hepatic artery proper and gastroduodenal artery. Later, the hepatic artery proper gave left and right hepatic arteries near the porta hepatis (Fig. 1). There were two cystic arteries: one was too long and the other was short (Fig. 3). One of the cystic arteries branched from the hepatic artery proper and the other arose from the right accessory hepatic artery (RAHA). These two cystic arteries supplied one GB each (Fig. 3).

DISCUSSION

During the 3rd week of intrauterine life, the cells from the hepatic bud proliferate towards the septum transversum and lead to the formation of the bile duct. This small ventral outgrowth, which forms the bile duct, also contributes to the formation of the GB along with the cystic duct (Sadler, 2017). The GB developing from the caudal end of the hepatic diverticulum happens in the 4th week of development (Gotohda et al., 2000). The embryological basis of the duplication of the GB is due to unusual branching of the developing biliary tree during the division of the caudal end of the hepatic diverticulum (Kothari et al., 2005). Boyden (1926) classified the double GB morphologically into bilobed GB and true duplication. True duplication, which was noted by him, was divided into Y and H-shaped GBs. In H-shaped double GB, two cystic ducts coming from two different GB enter the common bile duct. Whereas in 'Y-shaped' GB, two cystic ducts

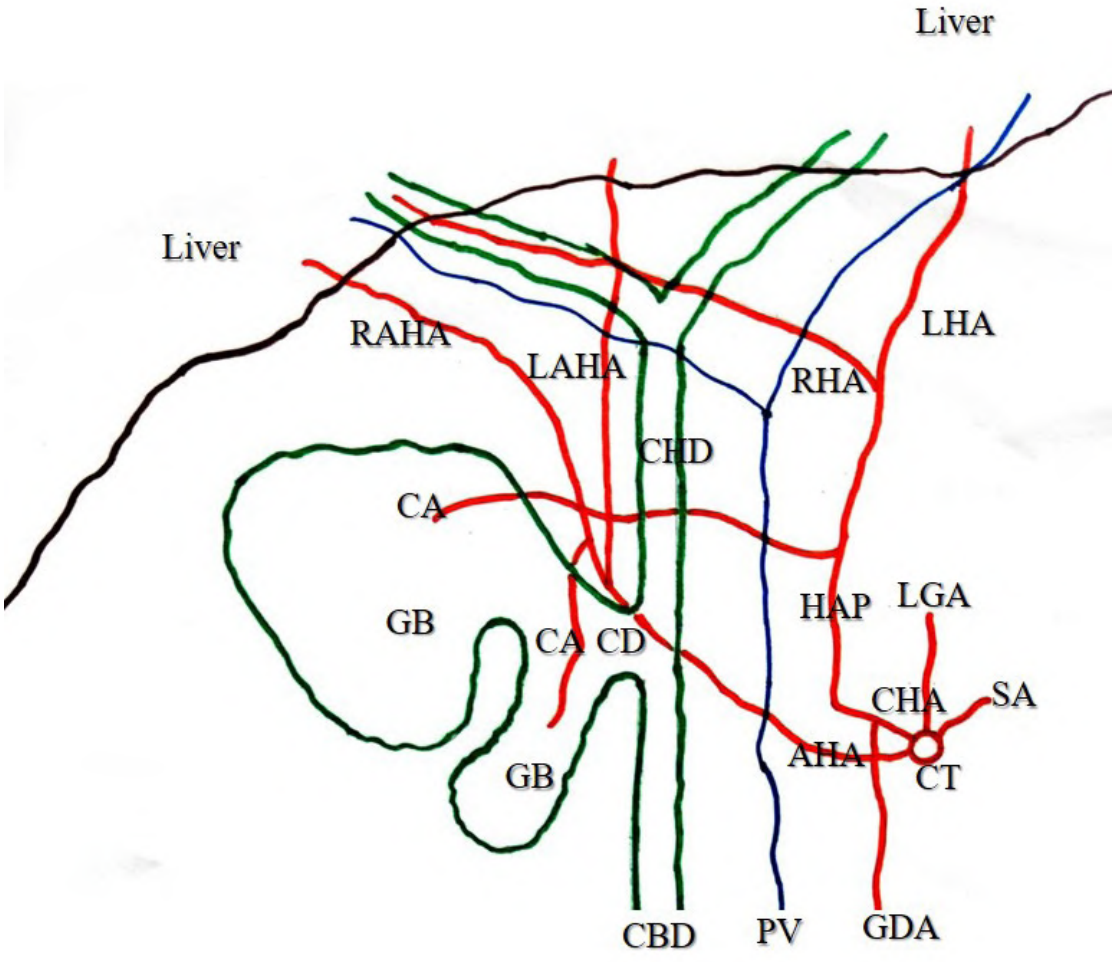

Fig. 2.- Schematic representation of the 'Y' shaped gallbladder associated with accessory cystic and hepatic arteries in this study.

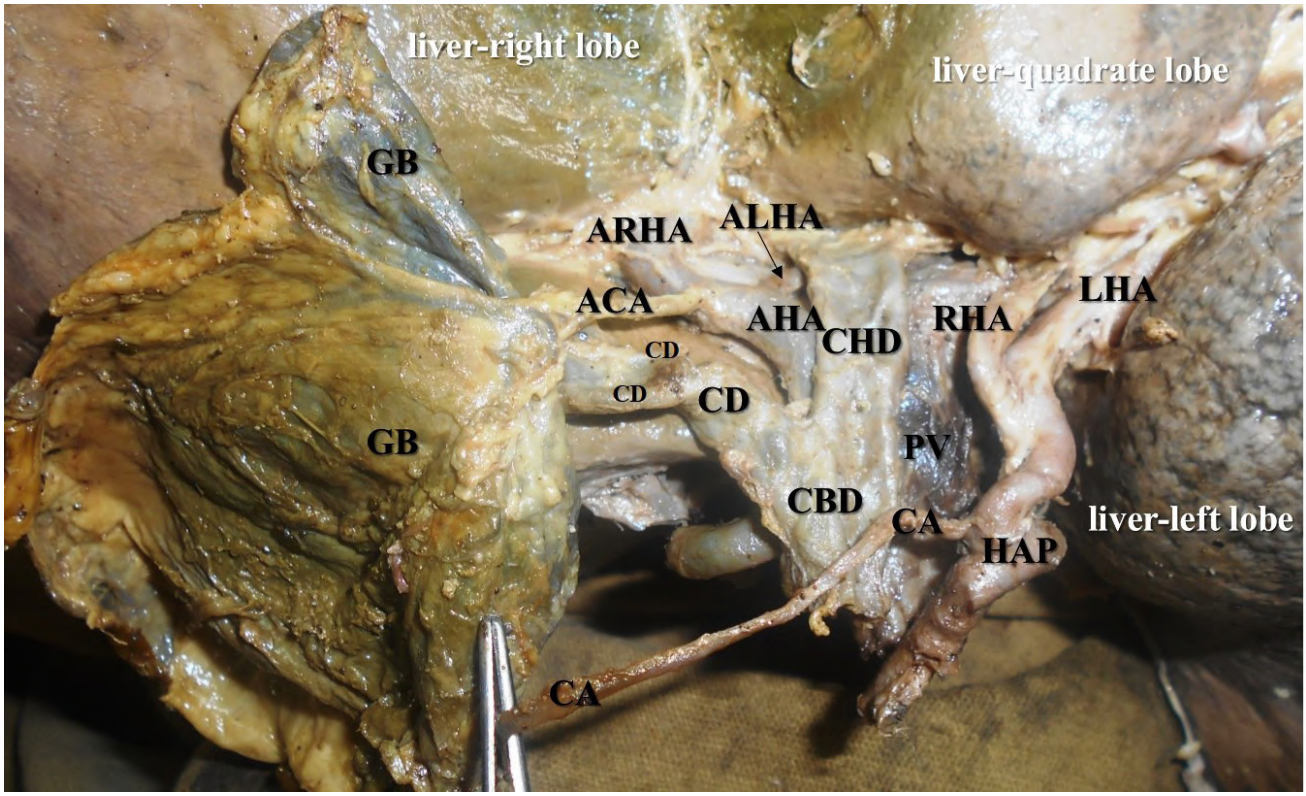

Fig. 3.- Picture of the same anatomical variation of the 'Y' shaped gall bladder, which is showing the ACA. It is clearly seen that their ducts were short and fused to form a single cystic duct (ACA-accessory cystic artery, ARHA-accessory right hepatic artery, ALHA-accessory left hepatic artery.

Fig. 4.- Showing the interior of both the gall bladders (↓) and there were no gall stones.

join together and enter into the CBD. In 'Y-shaped' GB, both the GBs occupy the single GB fossa. In the present case, it was observed that the GBs had a single cystic duct, and this morphological variant falls into 'Y-shaped' GB as per Boyden's (1926) classification. The 'Y' GB occurs when two separate GBs, each with its own cystic duct, form a common cystic duct before entering the common bile duct (Apolo Romero et al., 2018). Due to the bifurcation of primordial GB, the case of true duplication is seen in the 5th and 6th weeks of intrauterine life (Mazziotti et al., 2001).

The ultrasound evaluation of GB is routinely done for the right hypochondriac pain. This is highly sensitive in assessing the gallstones, cholecystitis and detecting anatomical variations of the GB. However, in the setting of patients with double GB, ultrasonography scanning might not rule it out from other conditions, like choledochal cyst (Apolo Romero et al., 2018). Double GB is usually asymptomatic and the chance of getting the disease in it is equal to the normal GB (Goiney et al., 1985). Gigot et al. (1997) opined that the commonest complication of double GB is cholelithiasis, which can occur either in one lobe or both lobes. The surgical removal of GB is not advised in these patients of double GB, who did not show any symptoms. However, cholecystectomy is recommended in symptomatic patients. Both the GBs should be removed at a time, even if the disease is seen only in one of the lobes.

Morphological knowledge about variations of the hepatic arterial tree-like AHA is important. During upper abdominal surgeries, it is essential to preserve the hepatic arterial supply to prevent complications like hepatic ischemia. Failure of identification of AHA can lead to iatrogenic injury to this vessel, which can lead to catastrophic bleeding. The origin of the cystic arteries is often variable. It is described as a branch of the right hepatic artery, but may also originate from the hepatic artery proper. In the present case, there were two cystic arteries, one of them branching from the RAHA, and the other from the hepatic artery proper. Rupture of cystic arteries can cause bleeding in the operation site and may obscure the laparoscopic view.

The most commonly performed laparoscopic procedure today is cholecystectomy (Rajapandian et al., 2017). The morphological knowledge about the double GB, accessory cystic and hepatic arteries may help laparoscopic surgeons if these are not diagnosed preoperatively. This has potential implications intraoperatively and postoperatively. It is suggested to perform an intraoperative cholangiogram during the cholecystectomy procedure for the better delineation of biliary tree anatomy. This can prevent catastrophic vasculo-biliary complications (Rajapandian et al., 2017).

The morphological information on twofold GB, accessory hepatic, and cystic arteries can diminish the dangers of inconveniences because of biliary and blood vessel damage. The iatrogenic injury to the common bile duct or other important nearby structures can be prevented (Apolo Romero et al., 2018). Knowledge about the variations of the hepatobiliary region is enlightening to the advanced surgical techniques and modern technology. This will reduce the risk encountered during the surgical procedures in this region.

CONCLUSION

We believe that the present report is enlightening to the laparoscopic surgeons and radiologists to prevent misinterpretations and subsequent complications.

REFERENCES

APOLO ROMERO EX, GÁLVEZ SALAZAR PF, ESTRADA CHANDI JA, GONZÁLEZ ANDRADE F, MOLINA PROAÑO GA, MESÍAS ANDRADE FC, CADENA BAQUERO JC (2018) Gallbladder duplication and cholecystitis. *J Surg Case Rep*, 7: 1-3.

BADAGABETTU SN, PADUR AA, KUMAR N, REGHUNATHAN D (2016) Absence of the celiac trunk and trifurcation of the common hepatic artery: a case report. *J Vasc Bras*, 15: 259-262.

BOYDEN EA (1926) The accessory gallbladder. An embryological and comparative study of aberrant biliary vesicles occurring in man and in domestic mammals. *Am J Anat*, 38: 177.

GIGOT J, VAN BEERS B, GONCETTE L, ETIENNE J, COLLARD A, JADOUL P, THERASSE A, OTTE JB, KESTENS P (1997) Laparoscopic treatment of gallbladder duplication. A plea for removal of both gallbladders. *Surg Endosc*, 11: 479-482.

GOINEY RC, SCHOENECKER SA, CYR DR, SHUMAN WP, PETERS MJ, COOPERBERG PL (1985) Sonography of gallbladder duplication and differential considerations. *AJR Am J Roentgenol*, 145: 241-243.

GORECKI PJ, ANDREI VE, MUSACCHIO T, SCHEIN M (1998) Double gallbladder originating from left hepatic duct: a case report and review of literature. *JSLS*, 2: 337-339.

GOTOHDA N, ITANO S, HORIKI S, ENDO A, NAKAO A, TERADA N, TANAKA N (2000) Gallbladder agenesis with no other biliary tract abnormality: report of a case and review of the literature. *J Hepatobiliary Pancreat Surg*, 7: 327-330.

KOTHARI PR, KUMAR T, JIWANE A, PAUL S, KUTUMBALE R, KULKARNI B (2005) Unusual features of gall bladder duplication cyst with review of the literature. *Pediatr Surg Int*, 21: 552-554.

MAZZIOTTI S, MINUTOLI F, BLANDINO A, VINCI S, SALAMONE I, GAETA M (2001) Gallbladder duplication: MR cholangiography demonstration. *Abdom Imaging*, 26: 287-289.

NAYAK SB, SHETTY SD, SURENDRAN S, JETTI R, KUMAR N, SIRASANAGANDLA SR (2014) Double gallbladder completely enclosed in a cystogastric fold of peritoneum. *Anat Cell Biol*, 47: 132-134.

NAYAK SB, AITHAL AP, PADAVINANGADI A, PRABHU G (2018) Double pouched, sigmoid gallbladder that can cause a diagnostic dilemma to radiologists: a case report. *Anat Cell Biol*, 51: 209-211.

PUNEET, TIWARY SK, AGARWAL S, SINGH S, KHANNA A (2006) *Double gallbladder*. *Internet J Gastroenterol*, 4: 2.

RAJAPANDIAN S, JANKAR SV, NAYAK DS, CHITTAWADGI B, SABNIS SC, SATHYAMOORTHY R, PARTHASARATHI R, SENTHILNATHAN P, RAJ PP, PALANIVELU C (2017) Laparoscopic management of 'Y-shaped' gallbladder duplication with review of literature. *J Minim Access Surg*, 13: 231-233.

SADLER TW (2017) Langman's Medical Embryology. 13th ed. New Delhi: Wolters Kluwer, p 236.