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Original Research Article

THE CYSTIC ARTERY: AN OBSERVATIONAL STUDY AND CLINICAL SIGNIFICANCE OF ITS VARIANTS

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ABSTRACT

Background: Cystic artery variations are frequent and important for invasive as well as invasive procedure around the hepatibiliary area. Variation can be in term of origin, course and termination of CA.

Aim: Aim was to identify new type of Cystic arterial variation in term of origin, no. of CA, and termination and surgical implications of these variations.

Materials and methods: Study was carried out at department of anatomy, S.M.S Medical college and hospitals Jaipur (Raj). Total 60 cadaver were included in the study. Ethical clearance was taken for the same. Subjects with history of abdominal surgery around Hepatobiliary area were excluded.

Result: Source of origin of SCA was RHA (majority of cases), Aberrant RHA, SMA, HAP. DCA was observed in 13.34% cases. Accessory CA arose from RHA, ARHA, HAP, PSPD. Compound DCA was observed in 5% cases. Longer CA was observed in the study.

Conclusion: Variation related to CA are essential to keep in mind while dealing with Hepatobiliary area during invasive and non invasive procedures as well.

KEY WORDS: Cystic, Hepatobiliary, Cystic arterial variation.

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INTRODUCTION

Cystic artery arises from Right hepatic artery which is main arterial supply to biliary system along with left hepatic artery. Cystic artery arises inside the Calot's triangle usually. It supplies oxygenated blood to the Gallbladder and Cystic Duct. Before supplying Gall Bladder, it divides into superficial branch for peritoneal surface of GB and deep branch for non peritoneal surface of GB.

Cystic artery is single usually but double CA can be found. Origin & course of artery is also variable. This is most commonly injured artery during cholecystectomy due to frequent variations. Hemorrhage could be a problem during search of the CA if these variations are overlooked and that increases the rate of conversion to open surgery [1].

Gallbladder develops from hepatic diverticulum, which receives blood from coeliac trunk and superior mesenteric artery. Most of the vessels disappear during development, leaving mature vascular structure. Complex degeneration process leads to origin and branching

pattern of the vessels to this organs also vary considerably variable [2].

It also needs to be kept in mind that, during laparoscopic visualization, anatomical relations are seen differently compared to conventional cholecystectomy [3].

This emphasizes the importance of cystic arterial dissection and necessity of thorough knowledge of cystic arterial variations for safe performance of cholecystectomy [1].

Aim of the study was to identify variation in term of origin, no. and course of CA.

MATERIALS AND METHODS

This was an observational study carried out in department of Anatomy in our institute. 60 cadavers were included without history of abdominal surgery. Ethical clearance was obtained for the same from ethical committee of the institute.

The study followed by cadaveric dissection of Hepatobiliary area. Precise meticulous dissection was done to prevent injury to the Hepatobiliary area. All variations were noted and photographs were taken for the same. Measurements were taken with help of measuring scale & Vernier caliper. Origin and course was noted for CA.

RESULTS

Single CA was observed in 52(86.66%) cadaver, Double CA was noted in 8(13.34%) cadaver Out of 52 SCA, 34 SCA originated inside Calot's triangle, rest (18) was originated outside the triangle.(Table 1)

CA those arose outside the triangle,10(16.67%) of them Enters in the triangle passing anterior to Common Hepatic Duct/Common Bile Duct and 8(13.33%) cases it passed anterior to Cystic Duct (fig.2).

Cystic artery (SCA) originated from Right hepatic artery in majority of case (75%).in 8.34% case had origin from hepatic artery proper (HAP),6.67% SCA arose from Sup. Mesenteric artery. In 8.34% case of SCA originated from Aberrant RHA (named as Replaced RHA in few literature) (Table 2). 1.67% cases had CA arising from common hepatic artery.

Length of CA was observed between 4 mm to 52mm.average length was 23.85mm observed.(Table 3, bar chart.1)

Width of CA was ranged from 0.17 to 5mm. more than 50% cases were falling into 2-4mm group. Average diameter was 2mm observed. (Table 4, Bar chart:2)

Accessory CA was found in 13.33% cases. 6.67case of ACA has origin from RHA, 3.34% ACA arose from HAP,(fig.1) in 1.67 cases had ARHA (fig.3) origin. In 1.67% cases ACA arose from Posterior Superior Pancreatico Duodenal artery. (Table 2)(fig2)

5% cases had both arteries arose inside Calot's triangle, compound DCA (fig.1) was found in 5% case whereas both arteries arose outside(fig.2) the triangle in 3.34% cases.

In one case of SCA, SCA from RHA outside the triangle passes anterior to CHD and divides into superficial br. and deep branch at joining of Cystic duct with CHD.

Table 1: No. and distribution of CA in respect with Calot's Triangle.

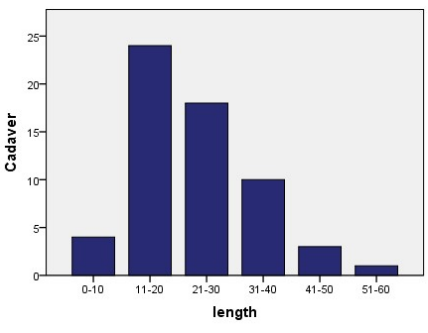
	Total no n (%)	Origin Inside the Calot's Triangle n (%)	Origin Outside the Triangle n (%)
Single CA	52(86.67)	34(56.67)	18 (30)
Double 1. ACA 2. Main CA	8(13.34)	4(6.67) 5 (8.34)	4(6.67) 3 (5)

Table 2: Source of origin of CA & ACA.

Source of origin	CA n (%)	ACA n (%)
RHA	45(75)	4(6.67)
SMA	4(6.67)	0
HAP	5(8.34)	1(1.67)
CHA	1(1.67)	0
Ab RHA	5(8.34)	2 (3.34)
PSPD	0	1(1.67)

Table 3: frequency of different group of length of CA.

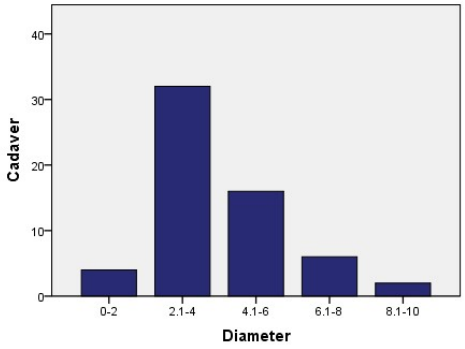
Length (mm) of CA	0-10	11-20	21-30	31-40	41-50	51-60
No of Cadaver	4	24	18	10	3	1



Bar chart .1: Frequency of length of CA.

Table 4: Frequency of different group of Diameter of CA.

Diameter (mm) CA	0-2	2.1-4	4.1-6	6.1-8	8.1-10
No of Cadaver	4	32	16	6	2



Bar chart.2: frequency of Diameter (mm) of CA.

Fig. 1: ACA arising from HAP (origin-CHA), CA arose from AbRHA.

Fig. 2: DCA, one CA arising from pancreatico-duodenal artery, both arteries passes inferiorly, parallel to CHD and CBD respectively. -Source of ACA-posterior sup pancreatico-duodenal artery

Fig. 3: ACA from ARHA

DISCUSSION

"Variation is rampant." Phrase by Sir Arthur Keith for biliary area is altered to read "variation is constant," [3] is befitting for cystic artery because of variation in its origin, no., & course.

Single CA was observed in present case 86.67%. This finding is consistent with Bhanasali SK [5] (2003) & other authors who describes single CA in 80-85% cases [6,7].

In 56.67% subject single CA was originated inside the triangle. Which was in concordance with Ramakrishna R [8] and Dandekar [1] reported similar in ~60% cases.

In case of origin of CA outside Calot's triangle, CA passes anterior to CHD/CBD in 16.67 % cases, which is similar to studies done by Andall et al. [9]. There study reported cystic artery passing anterior to the CHD in 17.9% cases. Daseler [10] reported similar incidence in 20% cases.

CA was situated anterior to CD in 13.91% case and superomedial to CD in86.67 % cases. This is in concordance with findings of Sing'ombe [11] in Zambian population. They observed 93.7% cadavers had the cystic artery superomedial to the cystic duct.

In case where Cystic artery lies anterior to bile duct it is first structure to be exposed during cholecystectomy, which makes it susceptible to injury [12]. Anterior course of CA is more prone to injury during cholecystectomy. Anterior to CD, CBD and CHD mar cause chances of injury to these ducts.

Cystic artery originated from RHA in 75% case in the present study, which is similar to findings of Daseler [12] & Michels N A [4]. Observation related to CA originating from HAP is similar to findings of Flinski et al. [13] Higher incidence of CA originating from SMA observed in the study, similar to reported by Kankhare et al [14] with 5%of population. Various case of origin from SMA have been reported (0.1-5%) in previous studies [10,15].

CA arising from SMA normally passes behind pancreas and may course behind the Duodenum. one must be careful while performing invasive procedure in this area. Incidence of

CA arising from ARHA was 8.34 % in present study which is similar to Dandekar et al [1] variable result have been reported for ARHA from .9-16 in literature [10,16].

Knowledge of abnormal source of origin of CA is must to avoid injury to the artery, as it originates outsides the calot's triangle in this case. Higher incidence of variability of origin of CA can be best understood on the basis of development. During development hepatic diverticulum is supplied by branches of aorta. With the time most of the branches degenerates leaving few nearer branches to supply the duct system. But degeneration is highly variable that clarify different source of origin of CA.

Length of Cystic artery was ranged from 4 -52mm in present study. Incidence of short CA (<1) was found in 6.67% cadaver which is similar Taimur et al. [17], They found short CA in 7% population. Length range between1-3cm was found in 70% cadaver that coincides with study of Dandekar et al. [1], they found this incidence in 73% population. Longer CA found in 23.33% cadaver in present study which is similar to finding of Singombe et al. [11], They found long CA (>4 cm) in 21.9% population. This is higher than reported in previous studies [1,17].

Average length of CA was observed 23.85mm in present study which is similar to reported by Marniok et al. [18]. Longer or abnormally shorter CA indicates abnormal origin and course of artery. It must not be confused for other arteries in this area.

Diameter of CA ranged between .1-5 which coincides with that of Dandekar et al [1]. Diameter was more in present study than previously reported literature. Widest CA was of 5 mm size which is similar to reported by Polguj [19]-5.1mm.

Presence of Double CA in present study (13.34%) was in accordance with Balija et al. [20], they documented double cystic artery in 13.6% population in their study on Western communities of Slovenians.

Compound CA was found in 3 cases (5%) cases. Similar to this N Qamar [21] reported CCA in 5.33% cases. Zubair [15] reported in 5.46% Suzuki [22] in 7.3% cases. Ding et al. [23] named cases where the cystic arteries existed not only in the Hepatobiliary triangle, but also outside it, i.e. the compound cystic artery type. They found 1.55% case with compound CA. Singh H. [24] reported incidence of compound CA in 1% population who underwent laparoscopic cholecystectomy.

Double CA arising from RHA was found in Calot's Triangle in 6.67% cases in present study Antonetti and Diaz [25] reported DCA in 7.3% case which is similar to present study, which is contrary to observed by Singh et al .they observed similar in 2.64% cases [26].

ACA originating from HAP was observed in 1.67% case which is similar to reported by Dandekar et al [1]. They observed similar case in 1.2% cases. Bincy MG et al [27] reported a case of double cystic artery and both arteries arose from the HAP.

Dolenšek [28] reported origin of ACA from ARHA which arose from SMA. In present case source of ARHA was SMA& CHA in two different cases. Loukas et al. [29] double cystic arteries originating both from Right hepatic artery and the PSPD artery. Similar case was reported in present study also. If ACA remain unidentified, it is prone to injury [1].

Knowledge of variation of CA is important because unrecognized cause of bleeding during cholecystectomy may lead to conversion in open surgery in 1.9% case and mortality in .02% [9].

CONCLUSION

In term of origin and course of CA, its frequent variations need to keep in mind while dealing with Hepatobiliary area, or it may lead to hemorrhage succeeded by injury to biliary duct also and may increase chances of injury to duct system also.

ABBREVIATION

CD- cystic duct
CHD- common hepatic duct
CBD- common bile duct
CA- cystic artery
AbRHA- aberrant right hepatic artery
ARHA- accessory right hepatic artery
SMA- superior mesenteric artery
PSPD- posterior superior pancreatico duodenal artery

HAP- hepatic artery proper
CHA- common hepatic artery
SCA- single cystic artery
DCA- double cystic artery

Conflicts of Interests: None

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