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"STUDY ON ANATOMICAL VARIATIONS OF HEPATIC ARTERY IN CADAVERS"

Dr. Anjali Raj Ladia[1] (First & Corresponding Author), Assistant Professor, Department of Anatomy, Shri Balaji Institute of Medical Sciences, Mowa, Raipur, Chhatisgarh.

Dr. Yashwant Kulkarni[2] (Second Author), Professor, Department of Anatomy, Government Medical College, Baramati, Maharashtra

Dr. Surekha Wamanrao Meshram[3] (Third Author), Associate Professor, Department of Anatomy, Government Medical College, Gondia, Maharashtra

ABSTRACT

Background: The rapid evolution and increasing complexity of liver-directed therapies have forced the medical community to further advance its understanding of hepatic arterial anatomy. The anatomy of the hepatic arterial bed has been demonstrated to have a high degree of variation. **Objectives of this study:** The objective of the study is to explore the variations of in HEPATIC ARTERIES in Cadavers of Anatomy Dissection. **Materials and Methods:** Dissection method was employed for this study. The dissection of hepatic artery was carried out in 60 cadavers which were embalmed using 10% formalin. Each cadaver was kept in supine position and its sex was noted. Each cadaver was dissected according to guidelines of "Cunningham's manual of practical anatomy volume two, fifteenth edition. Variations of hepatic artery were noted in terms of origin, diameter and length. **Discussion & Conclusion:** The findings of our study conclude that, the most common branching pattern of hepatic arterial system is type-I (80%) as per Michel's classification, incidence of variation in branching pattern of hepatic artery is 20%, incidence of replaced right and left hepatic arteries is same (8.33%) whereas replaced common hepatic artery is 3.33% and Variation of hepatic artery between male and female were not significant. No gender predilection for hepatic artery variation is seen in present study.

Key-words: anatomical variations, hepatic artery, cadaver, gender differences, branching pattern

INTRODUCTION

The rapid evolution and increasing complexity of liver-directed therapies have forced the medical community to further advance its understanding of hepatic arterial anatomy. The anatomy of the hepatic arterial bed has been demonstrated to have a high degree of variation[1]. Discrimination of normal arterial pattern from the variant is a key for safe and effective surgery Vascular anomalies are usually asymptomatic, until they interfere with the blood supply to the viscera. They are diagnosed accidentally during surgeries and diagnostic angiography[2].

The most common pattern of vascularisation as described by renowned anatomists as Testut, Moore, Sobotta and Netter, the coeliac trunk with origin from the aorta branches into the left gastric artery, splenic artery and common hepatic artery. The common hepatic artery, after the emergence of the gastroduodenal artery, continues as the proper hepatic artery and branches into right and left hepatic artery in the hepatic hilum [3-6]. This configuration is

adopted by most scholars of the subject, like Michels et al and Soin et al [7, 8]. According to the literature, variations in this arterial system occur approximately between 25 and 42%; Prabhasavat K. et al[9] reported variation of 16.5% in 200 cases, and Dutta S. et al[10] in 5% of 84 cases.

The anatomy of the hepatic artery is of great clinical significance for general surgeons, surgeons in hepato-biliary-pancreatic area and radiologists, mainly for interventional radiologic treatments. With laparoscopic surgery, there is a need for exact descriptions of the course of the hepatic artery to avoid vascular injuries[13]. These exact descriptions can be reported by the anatomists, surgeons and radiologists so that all information can be integrated and used for the patient's wellbeing[14]

The presence of replaced hepatic arteries can be lifesaving in patients with bile duct cancer because they are away from the bile duct and hence not affected by cancer, making excision of the tumour feasible. Knowledge of these variations is also important in planning the whole and split liver transplantation[15].

OBJECTIVES OF THE STUDY:

The objective of the study is to explore the variations of in HEPATIC ARTERIES in Cadavers of Anatomy Dissection.

MATERIALS AND METHODS

Study site: This study was conducted at the Department of Anatomy S Shri Balaji Institute of Medical Sciences, Mowa Raipur.

Study population: 60 cadavers, comprising of 35 males and 25 females.

Time frame to address the study: January 2021 to December 2021.

Inclusion Criteria: cadavers of both the genders in anatomy dissection hall of shri Balaji institute of medical sciences.

All embalmed adult cadavers available during the study period, approximate age ranging between 25 to 60 yrs of either gender.

Exclusion Criteria:

Any cadaver with pathology in supracolic compartment that was interfering the dissection.

Technique and Tools & **Data collection:** Dissection method was employed for this study. The dissection of hepatic artery was carried out in 60 cadavers which were embalmed using 10% formalin. Each cadaver was kept in supine position and its sex was noted. Each cadaver was dissected according to guidelines of "Cunningham's manual of practical anatomy volume two, fifteenth edition. A midline skin incision extending from xiphoid process to the umbilicus was given. Then an incision from the xiphoid process along the costal margin to a point on the midaxillary line was made. A transverse skin incision from the umbilicus to the midaxillary line was made. The skin was reflected from medial to lateral aspect towards the midaxillary line. Anterior abdominal wall was dissected layer by layer. Muscles of anterior abdominal wall were incised and reflected laterally. Stomach and greater omentum were identified and lifted to reveal the omental bursa. The anterior layer of the peritoneum was removed from the lesser omentum and right gastric artery was identified which was traced to the common hepatic artery. Common hepatic artery was carefully exposed by blunt dissection through retroperitoneal fat and upper margin of the pancreas up to the porta hepatis, exposing its branches.

The following observation were made and noted.

1. After identifying common hepatic artery, any abnormality or variation in its course/branching pattern were noted and photographs were taken with Nikon coolpix 5 Megapixel digital camera with 3x optical zoom.

2. Length of all the hepatic arteries were measured with the help of thread and measuring scale and diameter were measured with the help of digital vernier caliper from the outer wall to outer wall of the vessel.

3. Length of common hepatic artery was measured between the points of origin of common hepatic artery from the coeliac trunk to the origin of the gastroduodenal artery.

4. Length of hepatic artery ‘proper' were measured from the point of origin of gastroduodenal artery to the point to its bifurcation.

5. Length of right and left hepatic arteries were measured from the point of bifurcation of hepatic artery ‘proper' upto its entrance into liver parenchyma.

Statistical Analysis

Frequency and percentage were calculated for qualitative data and data was analyzed by chi-square test as test of significance.

Data were expressed as mean ± SD. The Student t test was used for the comparison. Statistical analysis was done using Microsoft Excel spreadsheet, and statistical package for the social sciences (SPSS) version 20.0 software.

RESULTS

We included a total of 60 cadavers, which comprised of 35 males and 25 females, the parameters studied include origin, course, length and diameter of hepatic artery.

Table 1: Shows the number and distribution of cadavers

Gender	Total number	Percentage
Males	35	58%
Females	25	42%
Total	60	100%

Table 2: Shows the Anatomical Variations of Hepatic Artery

S.No	Hepatic Artery Anatomy	Number	Percentage
1	Classic/Normal	48	80%
2	Common Hepatic Artery originating from Superior Mesenteric Artery	2	3.33%
3	Replaced Right hepatic artery originating from SMA	5	8.33%
4	Replaced Left hepatic artery originating from LGA	5	8.33%

It is evident from the above table 2 that out of total 60 dissected cadavers, 48 had normal course, 2 had origin from SMA, 5 had had replaced right hepatic artery originating from SMA and 5 had replaced left hepatic artery originating from left gastric artery.

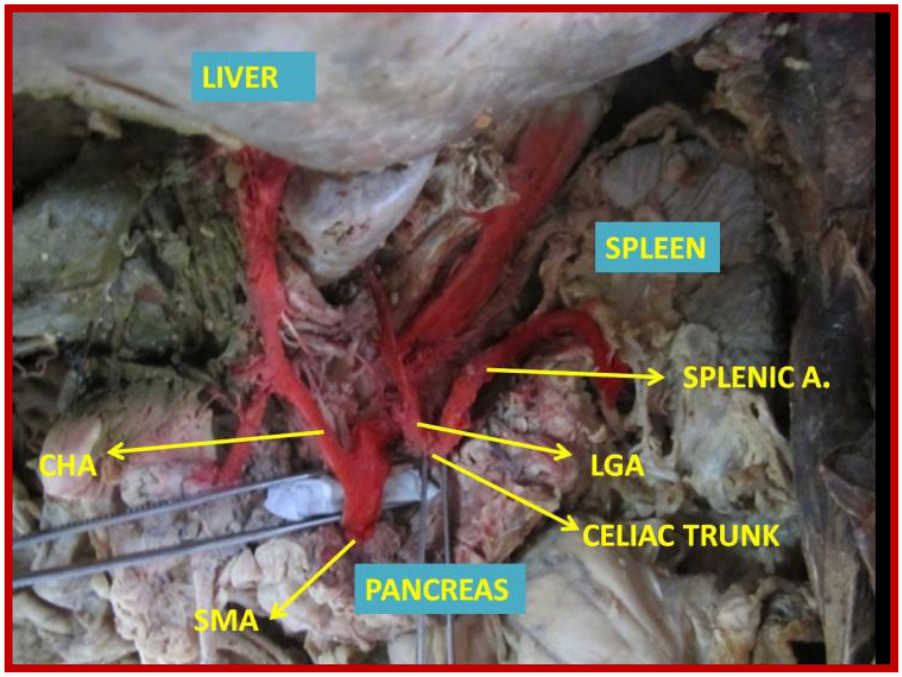

Figure 1: Shows normal branching pattern of hepatic artery of Coeliac Artery

Table 3: Shows gender wise distribution in normal, variant and total cases of hepatic artery			
Gender	**Normal (Css)**	**Variant (Css)**	**Total**
Male	26(0.14)	9(0.57)	35
Female	22(0.20)	3(0.8)	25
Total	48	12	60

CSS-Chi-square statistics

It is evident from the above table that the text book arrangement of normal branching pattern of hepatic artery where common hepatic artery originated from coeliac trunk and divided into right and left hepatic were seen in 26 Males and 22 Females. Out of the 12 variant cases, 9 were found in male and 3 were found in female. The chi-square statistics was 1.7143. The p-value was 0.19043. This result was not significant at $p<0.05$.

Table 4: Shows the Comparison of Mean Diameter (mm) of Normal and Variant Hepatic Arteries				
Artery	**Normal**	**Variant**	**t-value**	**P-value**
Common hepatic artery	4.92 ± 0.30	5.50 ± 0.30	2.68	0.009
Right hepatic artery	3.50 ± 0.37	3.22 ± 0.18	1.66	0.1014

Left hepatic artery	2.81 ± 0.43	1.88 ± 0.17	4.77	0.00

It is evident from the above table that the mean diameter of normal common hepatic artery was less than variant and the difference between them was significant. The mean diameter of normal right hepatic artery was more than variant but the difference between them was non-significant. The mean diameter of normal left hepatic artery was more than variant and the difference between them was significant.

Table 5: Shows the comparison of mean length (cm) of normal and variant hepatic arteries

	Normal	Variant	t-value	P-value
Common hepatic artery	2.56 ± 0.39	3.1 ± 0.40	1.92	0.06
Right hepatic artery	3.14 ± 0.39	8.0 ± 1.41	19.70.	0.00
Left hepatic artery	2.25 ± 0.44	4.12 ± 0.54	8.94	0.00

It is evident from the above table that the mean length of normal common hepatic artery was less than variant and the difference was non-significant. Mean length of normal right hepatic artery was less than variant and the difference was significant. Mean length of normal left hepatic artery was less than variant and the difference was significant.

DISCUSSION:

Variations in the hepatic arterial pattern which has been reported in the literature are purely based on the origin of the hepatic artery and its branching pattern. The understanding of anatomy of the right and left hepatic artery as well as knowledge of type of anatomical variants involving these vessels is essential for proper pre-operative vascular planning in surgical or radiological procedures in the upper abdomen.[16-19]

Anatomical knowledge of variants of hepatic artery is required to reduce the iatrogenic complications in hepatobiliary surgeries, surgical management of liver trauma, aneurysm of hepatic artery, hepatic arterial infusion chemotherapy, liver transplant surgery, pancreaticoduodenectomy, radical gastrectomy and such other surgeries of this complex anatomical region. These variants are relevant in cholecystectomy because they affect the laparoscopic appearance of porta hepatis. The anatomical variations of the hepatic artery can be explained on embryological from the longitudinal anastomosis. These branches are usually separated from the 13th root. After head folding, the embryo has bilateral primitive aortae, each consisting of ventral and dorsal parts that are continuous through the first embryonic aortic arches. The ventral aortae are fused and form a dilated aortic sac. The dorsal aortae run caudally, one on each side of the notochord. Each dorsal aorta gives paired ventral splanchnic branches which supply the yolk sac, the primitive gut and its derivatives. With the fusion of the dorsal aortae during the 4th week of intrauterine life (IUL), the ventral branches fuse and form a series of several unpaired segmental vessels, which run in the dorsal mesentery of the gut and are connected by the ventral longitudinal anastomosing channel. With the formation

of the longitudinal anastomotic channel, numerous ventral splanchnic branches are withdrawn & ultimately only three trunks persist as coeliac artery for the foregut, superior mesenteric artery to the midgut, and inferior mesenteric artery to the hindgut. According to Tandler, the 11th and 12th ventral segmental roots disappear; the 10th and 13th roots remain connected via the ventral anastomoses. The common hepatic, left gastric and splenic arteries usually originate the future superior mesenteric artery). If this separation takes place at the higher level, branches of the coeliac trunk are displaced to the one of the superior mesenteric artery. Although the number of specimens examined in the present study is relatively small, the observations with respect to the origin of all branches are comparable to previous reports. The issue of whether the embalming process results in changes in vessel characterstics (length, diameter) has not been addressed; however, the assumption has been made that any changes that might have occurred will be consistent across all vessels, and as such the vessels of interest in this study will have been affected in proportion to their size.[20-23]

CONCLUSION:

The findings of our study conclude that, the most common branching pattern of hepatic arterial system is type-I (80%) as per Michel's classification, incidence of variation in branching pattern of hepatic artery is 20%, incidence of replaced right and left hepatic arteries is same (8.33%) whereas replaced common hepatic artery is 3.33% and Variation of hepatic artery between male and female were not significant. No gender predilection for hepatic artery variation is seen in present study. The sample size in present study is relatively small. If it was large the result would be more generalised.

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