"THE STUDY OF HEPATIC ARTERY VARIATION IN HEPATODUODENAL LIGAMENT IN CO-RELATION WITH SURGICAL ANATOMY OF LIVER TRANSPLANTATION"

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ABSTRACT:

Background: *Variation of hepatic artery in the hepatoduodenal ligament is very frequent, hence it is important to identify its branches before any surgery is attempted in this area, because injury to these structures may result in troublesome hemorrhage, even the inadevarant ligation to the right or common hepatic arteries results into hepatic infarction, necrosis or so called liver death. Hence the study of variations in hepatic pedicle is of interest to both surgeons and anatomist.*

A**ims and Objectives:** *The present study was undertaken to evaluate the presentation of branching patterns of hepatic artery in the hepatic pedicle. Aim was to study variation of proper hepatic artery and to co-relate its importance in liver transplantation.*

Material and Methods: *A total of 100 cadavers were dissected as per the routine method with routine instruments. The hepatoduodenal ligament was dissected and hepatic artery was followed towards the porta hepatis. The branching patterns of proper hepatic artery was noted. After collecting the data, statistical analysis was done.*

Observations: *Results showed the normal branching patterns of proper hepatic artery in 86% cadavers and remaining 14% cadavers had variations which were of 3 types.*

Discussion and Conclusion: *The study shows significant frequency of variations in the anatomy of proper hepatic artery. Hence a detailed study of this structure is warranted before and during hepatic transplant and other procedures in this to avoid post-operative complications such as biliary ischemia, stricture or hemorrhage.*

Key words: *Hepatoduodenal ligament, Proper hepatic artery, Liver transplant.*

INTRODUCTION

Transplantation means implanting, in one part of a body, a tissue or an organ taken from another part or from another individual. In western mythology, women in his Iliad described the monstrous chimera created by Gods who had heads of lion, goat and serpent. The term chimera is still used to describe an individual who possesses hybrid character such as circulating cells of both donor and recipient after bone marrow transplant [17].History in Indian Mythology does have examples of transplantation such as Lord Ganesha with head of an elephant, Lord Narsimha with head of Lion and hands of tiger. IST transplant reported was of kidney by Ullman E. in 1902[21]. Ist successful liver transplant was performed on pediatric patient in 1967 by Starzl [19]. Liver transplantation has now become a routine procedure in many countries. Hence study of variation in proper hepatic artery is of interest to both the Surgeons and the Anatomist.

LEGAL ASPECT AND SURGICAL ANATOMY OF LIVER TRANSPLANTATION

In 1968 the Uniform Anatomical Gift Act (UAGA) was established in USA. This act allows that at the time of death, organs (liver, kidney etc.) may be offered for donation by donor. It is important for everyone to communicate his/her wishes regarding organ donation to the family.

The Bombay Anatomy Act 1949 was first published in Bombay Government Gazette on 22nd April, 1949. The Transplantation of Human Organ Act was published in Gazette of Maharashtra Government on 23rd Feb., 1995.There are defined ethical guidelines as per I.C.M.R. 2000 for live donor transplant, cadaver donor transplant and recipient transplant [9].

The surgical anatomy of liver transplantation was studied under following aspects….

1. Hepatic segmentation and surgical anatomy of hepatoduodenal ligament- The hepatoduodenal ligament is a part of lesser omentum extending from hilum of liver to first 2cm of duodenum. The contents of hepatoduodenal ligament are proper hepatic artery, portal vein and common bile duct. The relations of these structures in the ligament are proper hepatic artery on right side, common bile duct on the left side while portal vein lies behind the proper hepatic artery and common bile duct [22].
2. Surgery in donor - In this segment hepatectomy in cadaver donor was studied in respect to anatomical aspects of mobilization of various

structures as well as preparation of liver for transplant [14].

3. Surgery in recipient – It includes recipient hepatectomy and cadaver donor liver transplantation [12].
4. Surgical aspects of split liver transplant and pediatric transplant - It includes many categories such as reduced sized liver transplantation, living donor liver transplantation and split liver transplantation procedures [15].
5. Anatomical aspects of complications-This head includes anatomy of postoperative complications occurred in transplantation procedures [4, 8].

AIMS AND OBJECTIVES

Looking to the large number of patients waiting, liver transplantation is now an established surgical treatment all over the world.

Following are the aims.

a) To study hepatoduodenal ligament for its morphology, proper hepatic artery and its variation.
b) To discuss the problems related to surgical anatomy faced by surgeons during liver transplantation.
c) To discuss the surgical anatomy of proper hepatic artery in light of recent knowledge of liver transplantation.

MATERIALS AND METHODS

A total of 100 cadavers were dissected which included 58 male and 42 female cadavers, the age ranged between 20-80 years. Dissecting instruments used were forceps, scalpel, B.P. handle with knife blade, scissors, needles etc.

Dissection of hepatoduodenal and gastrohepatic ligament was done to study the contents with their inter relationship after opening the anterior abdominal wall. This included dissection of right and left gastric vessels, extrahepatic biliary apparatus, celiac trunk with its branches and the dissection of portal vein with its tributaries. Finally the dissection of inferior vena cava was carried out and porta hepatis was exposed [16].The branching patterns of proper hepatic artery was noted.

For statistical analysis a master chart was prepared containing date of dissection, cadaver number, sex of cadaver and the patterns of vessels seen in the dissection.

OBSERVATIONS

Observations of the present work were described under branching patterns of proper hepatic artery (Pattern A, B, C, D).

The various types of branching patterns of proper hepatic artery seen in the present work are-

Pattern A (86%) - Proper hepatic artery divided into two branches at hilum as right hepatic artery and left hepatic artery. The cystic artery was arising from right hepatic artery.

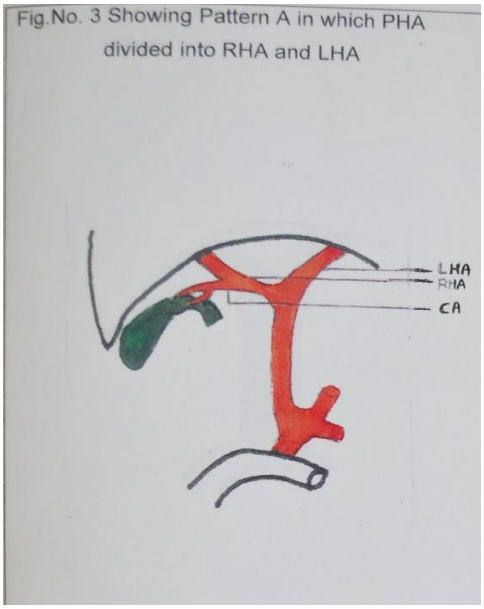


Fig.No. 3 Showing Pattern A in which PHA divided into RHA and LHA

(LHA-Left Hepatic Artery, RHA-Right Hepatic Artery, CA-Cystic Artery, MHA-Middle Hepatic Artery**)**

Pattern B (9%) - Proper hepatic artery divided into 3 branches at hilum as right hepatic artery, left hepatic artery and middle hepatic artery. The cystic artery was arising from right hepatic artery.

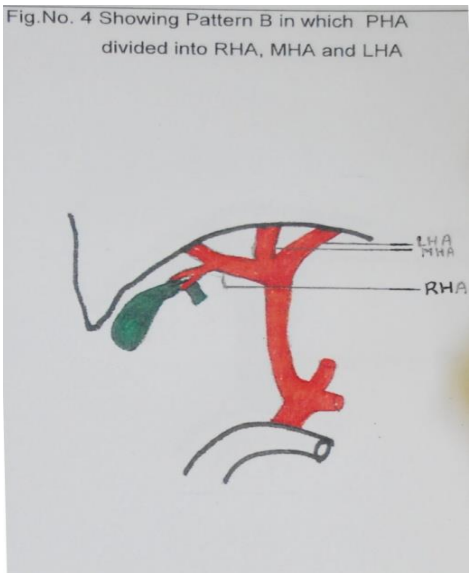


Fig.No. 4 Showing Pattern B in which PHA divided into RHA, MHA and LHA

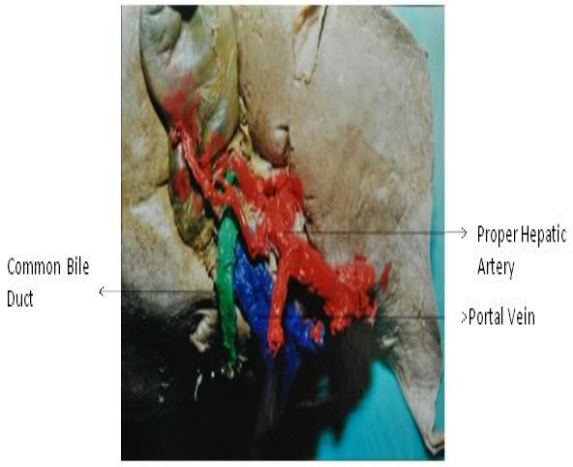
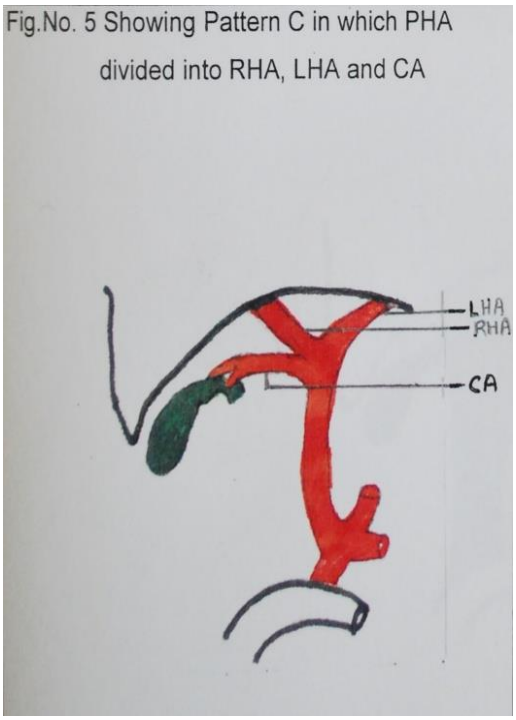


Fig. 1 Showing Normal Pattern of Proper Hepatic Artery, Portal Vein, Common Bile Duct

(LHA-Left Hepatic Artery, RHA-Right Hepatic Artery, CA-Cystic Artery, MHA-Middle Hepatic Artery**)**

Pattern C (4%) - Proper hepatic artery divided into 3 branches at hilum as right hepatic artery, left hepatic artery and cystic artery. The cystic artery was arising from proper hepatic artery.



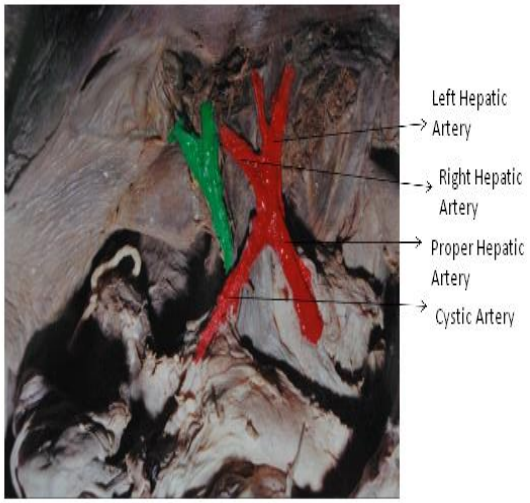
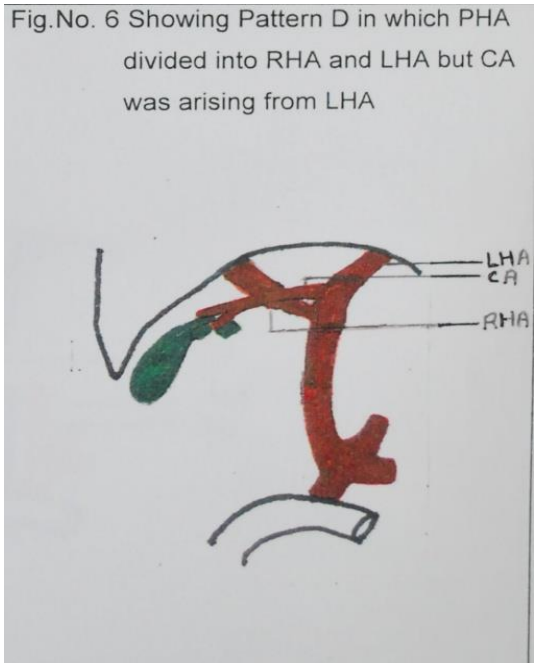


Fig. 2 Shows Pattern C, in which Proper Hepatic Artery divided into Right Hepatic Artery, Left Hepatic Artery & Cystic Artery.

(LHA-Left Hepatic Artery, RHA-Right Hepatic Artery, CA-Cystic Artery, MHA-Middle Hepatic Artery**)**

Pattern D (1%) - Proper hepatic artery divided into two branches at hilum as Right hepatic artery and left hepatic artery. The cystic artery was arising from left hepatic artery.



(LHA-Left Hepatic Artery, RHA-Right Hepatic Artery, CA-Cystic Artery, MHA-Middle Hepatic Artery**)**

DISCUSSION

The present study when compared with some previous similar studies shows various types of branching patterns of proper hepatic artery. Flint ER (1923) studied abnormalities of right hepatic artery, cystic artery and gastroduodenal artery and of the bile duct in 200 cadaveric dissection [6].Browne EZ (1940) studied variation in origin and the course of the hepatic artery in 280 cases [3].Yamaguchi T, et al (1993) described the surgical procedure to reconstruct the hepatic veins to obtain an optimal graft volume for the recipient in partial liver transplantation [23].

Daseler EH(1947)noted absence of common hepatic artery in 12.2 of cases[4]. In the study done by Daseler et al (1947), they found pattern A in 83.2%, pattern C in 9.1% while pattern D in 0.9% of cadavers [4]. Browne (1940) and Thompson IM (1993) also noted pattern C and pattern D of proper proper hepatic artery in less than 2% cadavers [3, 20]. While looking at relatively less number of studies done related to combined variations of all three structures in hepatoduodenal ligament, the present work is conducted, with special consideration to various aspects of liver transplantation surgery. Some surgeons recommend routine arteriography of the graft before splitting. Although an arteriogram may alert to the possibilities of aberrant vasculature, it does not provide information about the relation of abnormal vessels to the other portal structures. The incidence of hepatic artery thrombosis varies in centers where grafts are routinely assessed by presplit angiography. Rela M et al (1998) therefore favor careful dissection over angiography as a means of defining the arterial anatomy[24].

CONCLUSION

The pioneer of liver transplantation probably never envisioned the current scenario in which demand for donor livers far exceeds the supply. For procedures involving exploration of biliary tree, surgeons must have knowledge of location, course and the potential variation of artery supplying the region. They may be encountered during variety of biliary procedures but are probably most significant during laparoscopic cholecystectomy [1, 7].

In split liver transplantation, living donor liver transplantation method is used and is performed in pediatric patient. Here in the donor, if accessory segmental right proper hepatic artery is present, the liver may not be suitable for splitting. Injury to any segmental artery in the transplanted liver may cause ischemic cholangiopathy or infarction of the supplied segments. Major problem of pediatric liver transplantation is a shortage of pediatric donor, main reason being lack of appropriately sized donors [2, 18].

During hepatic transplant, care should be taken while clearing the cystic and bile duct especially to preserve their blood supply. The replaced, aberrant and multiple hepatic arteries should be looked for and if present proper care should be taken to avoid post-operative ischemia and hemorrhage. Post-operative findings based on M.R.I. and C.T. scan should be confirmed on the operation table as sometimes some structures remains undetected. Precise pathogenesis of post-operative bile duct strictures is not yet fully understood. The presence of isolated sectoral duct may lead to post-operative leakage. The anastomosis between donor and recipient ducts must be constructed with blood supply of each duct keeping in mind [5, 10, 11].

The Anatomy department should promote cadaver organ transplant programme by creating awareness among the general public and concerned medical fraternity. The communities should be educated about the latest treatment modalities of cadaver organ transplant and share the success stories with them. The chapter of surgical anatomy of transplantation should be first added in detail in the syllabus of postgraduate studies and in brief in the syllabus of undergraduate studies.

ACKNOWLEDGEMENT

I would like to acknowledge and extend my heartfelt gratitude to the following persons who have made the completion of this Manuscript possible:

Our Director, DR.P H SHINGARE, for his vital encouragement and support.
DR. C V DIWAN our Professor and Head, Department of Anatomy. For her understanding and assistance.
All faculty members and Staff of Department of Surgery, GMCH Aurangabad.
Most especially to my family and friends.
And to God, who made all things possible.

Conflict of Interest: The authors declare no conflict of interest concerning the materials or methods used in this study.

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