The Study of Variation of Structures in Hepatoduodenal Ligament and Its Co-Relation with Surgical Anatomy of Liver Transplantation

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Research Article

Abstract: Variations in biliary tree and its associated vascular elements are very frequent, hence it is important to identify major structures in this area before surgery is attempted, because injury to these structures may result in troublesome hemorrhage and subsequent injury to common bile duct or hepatic ducts or even the inadevarant ligation to the right or common hepatic arteries results into hepatic infarction, necrosis or so called liver death. Similarly variations in duct system can be basis of serious and fatal complications. Hence the study of variations in hepatic pedicle is of interest to both surgeons and anatomist.The present study was undertaken to evaluate the presentation of types and frequency of variations of structures in hepatic pedicle. Aim was to study hepatoduodenal ligament for its morphology, contents and variation of its contents and to co-relate its importance in liver transplantation.A total of 100 cadavers were dissected as per the routine method with routine instruments. The hepatoduodenal ligament was dissected and its contents were followed towards the portahepatis. The branching pattern of hepatic artery and portal vein as well as morphology of extra hepatic biliary system was noted. After collecting the data, statistical analysis was done.Results showed the normal branching pattern of proper hepatic artery in 86% cadavers and remaining 14% cadavers had variations were of 3 types. The branching pattern of portal vein was normal in 56% cadavers while a variation in branching pattern of portal vein was seen in 44% cadavers.The draining pattern of extra hepatic biliary drainage system was normal in 90% cadavers and its variants were seen in 10% of cadavers. The number of cadavers having all 3 structures in normal pattern was 43% of cadavers only.The study shows significant frequency of variations in the anatomy of contents of hepatoduodenal ligament. Hence a detailed study of these structures is warranted before and during hepatic transplant procedures to avoid post operative complications such as biliary ischemia, stricture or hemorrhage.

Key words: Hepatoduodenalligament, Variations, 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.ISTtransplant reportedwas of kidney by Ullman E. in 1902[21]. Ist successful liver transplant was performedon pediatric patient in 1967 by Starzl [19]. Liver transplantation has now become a routine procedure in many countries. A clear understanding of blood supply of bile duct may provide important clues to pathogenesis of bile duct strictures and may explain the high incidence of biliary leakage and sludge formations when direct bile duct anastomosis is employed in human liver transplantation [13]. Hence study of variation in hepatic pedicle 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 Act1949 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 as ….

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 segmenthepatectomyincadaver 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 [14].
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].

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, content and variation of structures in it.
b) To discuss the problems related to surgical anatomy faced by surgeons during liver transplantation.
c) To discuss the surgical anatomy of hepatoduodenal ligament in light of recent knowledge of liver transplantation.

Observations

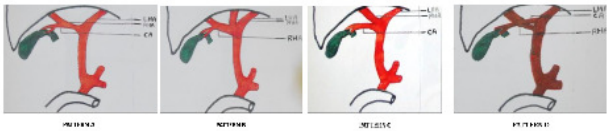
Observations of the present work were described under following heads
1. Branching pattern of proper hepatic artery (Pattern A, B, C, D).
2. Branching pattern of portal vein (Pattern a, b,c).
3. Draining pattern of hepatobiliarysystem (Patterni, ii, iii, iv, v).
4. Collective observations of proper hepatic artery, portal vein and bile duct in each Cadaver.

The various types of branching pattern 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 andleft hepaticartery. The cystic artery was arising from right hepatic artery.
Pattern B (9%) -Proper hepatic artery divided into 3 branches at hilum as right hepatic artery,left hepaticartery andmiddle hepatic artery. The cystic artery was arising from right hepatic artery.
Pattern C (4%) - Proper hepatic artery divided into 3 branches at hilum as right hepatic artery,left hepaticartery andcystic artery. The cystic artery was arising from proper hepatic artery.

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 wereforceps, scalpel, B.P. handle with knife blade, scissors, needles etc. Dissection of hepatoduodenal andgastrohepaticligament 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, extrahepaticbiliaryapparatus,celiac trunk withits branches andthe dissection of portal vein with its tributaries.Finally the dissection of inferior vena cava was carried out and portahepatis was exposed [16].The branching pattern of proper hepatic artery,portal vein and the draining pattern of hepatobiliary system wasnoted. For statistical analysis a master chart was prepared containing date of dissection, cadaver number, sex of cadaver and the pattern of vessels and bile duct seen in the dissection.
Pattern D (1%) -Proper hepatic artery divided into two branches at hilum as Right hepatic artery andleft hepaticartery. The cystic artery was arising from left hepaticartery.



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

The various types of branching pattern of portal vein seen in the present work are-

Pattern a (56%) -Portal vein divided into right portal vein and left portal vein at hilum.
Pattern b (43%) -Portal vein divided into right portal vein and left portal vein well before the hilum.
Pattern c (1%) -Portal vein was lying on right side of the proper hepatic artery and bile duct.

(PV- Portal Vein, LPV-Left Portal Vein, RPV-Right Portal Vein, PHA-Proper Hepatic Artery, BD-Bile Duct)

The various types of draining pattern of hepatobiliary system seen in present work are-

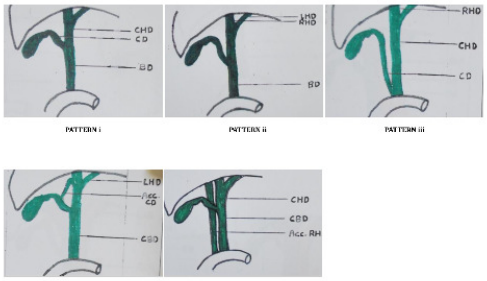
Pattern i(90%)- Common hepatic duct formed by joining right hepatic duct and left hepatic duct at hilum. The cystic duct joined the common hepatic duct near hilum to form bile duct.

Pattern ii (7%) -Common hepatic duct formed by joining right hepatic duct and left hepatic duct at hilum. The cystic duct joined the common hepatic duct in the midway between hilum of the liver and superior surface of duodenum to form bile duct.

Pattern iii (1%) -Common hepatic duct formed by joining right hepatic duct and left hepatic duct at hilum. The cystic duct joined the common hepatic duct at superior surface of duodenum to form bile duct.

Pattern iv (1%) -Common hepatic duct formed by joining right hepatic duct and left hepatic duct at hilum. The gall bladder drained by two cystic ducts, one duct drained into right hepatic duct and another drained into common hepatic duct to form bile ductnear hilum .

Pattern v (1%) -Common hepatic duct formed by joining right hepatic duct and left hepatic duct at hilum. The cystic duct joined the common hepatic duct near hilum to form bile duct. There was another duct drained into common bile duct behind the superior part of duodenum coming from right lobe of liver.



(CHD-Common Hepatic Duct, CD-Cystic Duct, RHD-Right Hepatic Duct, LHD-Left Hepatic Duct, CBD-Common Bile Duct, Acc CD-Accessory Cystic Duct, Acc RHD-Accessory Right Hepatic Duct)

Total 14 various types of combinations and patterns were observed in which A a i combination was in 43
cadavers while A b i combination was seen in 34 cadavers. Rest other 12 varieties of combinations were Seen in less than 4 cadavers.

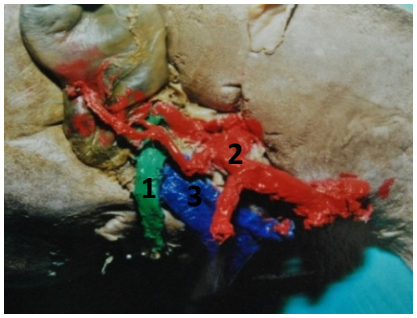


Fig.1: *showing normal pattern of Proper Hepatic Artery, Common Bile Duct, Portal Vein.*

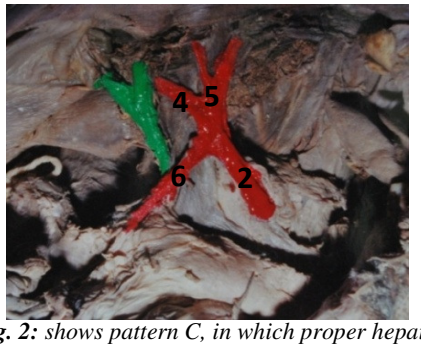


Fig. 2: *shows pattern C, in which proper hepatic artery divided into Right Hepatic Artery, Left Hepatic Artery and Cystic Artery*

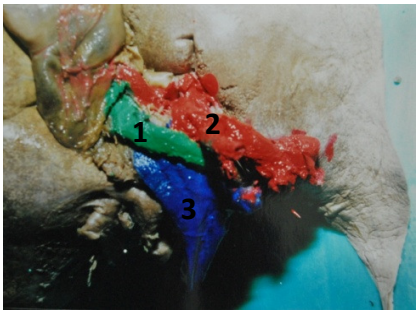


Fig. 3: *shows pattern c in which portal vein lying on Right side of Proper Hepati Artery and Comman Bile Duct*

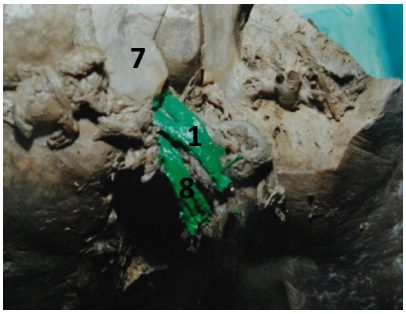


Fig. 4: *shows pattern V, in which additional duct was draining Right Lobe of Liver into Common Bile Duct behind the duodenum*

1. **Common Bile Duct**
2. **proper hepati artery**
3. **Portal Vein**
4. **Right Hepatic Artery**
5. **Left Hepatic Artery**
6. **Cystic Artery**
7. **Gall Bladder**
8. **Additional Duct**

Discussion

The present study when compared with some previous similar studiesshowsvarious types of branching pattern of proper hepatic artery. In one study done by Daseler et al (1947), they found patternA in 83.2%, pattern C in9.1% while patternD in 0.9% of cadavers [4]. Browne (1940) and Thompson IM (1993) also noted pattern C and pattern D of proper hepatic artery in less than2% cadavers [3, 20]. In branching pattern of portal vein, Thompson IM (1993) reported a single case of pattern c of portal vein, a finding same as in present study [20]. While comparing the results of bile duct draining patterns, JohnstonEV and Anson BJ (1952) quoted pattern i in 29%, pattern ii in 20%, pattern iii in 20% while pattern v in 31% cadavers[10]. Daseler et al(1947) also reported pattern iv and pattern v in less than 1%cadavers [4].Whilelooking atrelatively less number of studiesdone 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.

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.As in case of arterial and cystic duct aberrancies, common bile duct variations have significant surgical implications. They may be encountered during variety of biliary procedures but are probably most significant during laparoscopic cholecystectomy [1].

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 hepatic artery is present, the liver may not be suitable for splitting. Injury to any segmental artery in the transplanted liver may causeischemiccholangiopathy or infarction of the supplied segments. Major problem of pediatric liver transplantation is a shortage of pediatric donor, main reason being lack of appropriately sizeddonors [2, 18].

During hepatic transplant, care should be taken while clearing the cystic and bile duct especially to preserve their blood supply.Thereplaced, aberrant and multiple hepatic arteries should be looked for and if present proper care should be taken to avoid post-operativeischemia 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 keepingin mind [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.

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