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A NOVEL APPROACH OF GROSS STRUCTURE OF HUMAN LIVER

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ABSTRACT

This current exploratory research conducted to design for comprehensive study of human liver inorder to get best knowledge of learning objectives of its Gross structure. Topography of the liver was taken to know the exact position of liver. The weight, length of surfaces and borders were measured. It had two principal anatomical lobes based on attachment of ligaments and two functional lobes due to the distribution of blood and bile. It had five surfaces with one distinct border. Owing to the dichotomous divisions of the hepatic artery, portal vein and bile ducts it has to have eight vascular segments which can be resected without damaging those remaining. Apart from peritoneal covering it had been connected with falciform ligaments, Coronary ligaments, Triangular ligaments, Ligamentum teres, Ligamentum venosum. The nonperitoneal areas were fissures of ligamentum venosum, teres hepatis, Groove of inferior venacava, Fossa for gall bladder and bare area. It is an essential organ making proteins albumin and blood clotting factors, manufacturing triglycerides by emulsification of fat, synthesis of glycogen, bile production, stores vitamins, makes bile for digestion and detoxify metabolites. It is associated with certain medical conditions such as viral Hepatitis B, viral hepatitis Cirrhosis, Cancer which could be reflected in Liver Function Tests.

KEYWORDS: Liver, Principal lobes, Segments, Gall bladder, Bile duct.

INTRODUCTION

Hepar is the largest organ of human body after skin which comprises 2.5% of the total weight of the body in adult but in new born it proportionately larger of 5% of total body weight. In male weighs from 1.4 to 1.8 kg and in female 1.2 to 1.4kg with range from 1.0 to 2.5kg.[1] It is soft dark brown highly vascular organ which absorbs all nutrients from gastrointestinal tract by portal system. It is an accessory digestive gland produces bile which emulsify fat, makes protein and clotting factors and synthesis glycogen. In foetus it serves as a haemopoetic organ. It positioned mainly in the right hypochondrium which is maintained by the intra-abdominal pressure, hepatic veins, Inferior venacava and intra-abdominal pressure; secondary supports by right kidney, Hepatic flexure, deudenopancreatic complex and Tertiary supports by the connection between facliform ligament with anterior abdominal wall and coronary and triangular ligaments to the diaphragm. It has two principal lobes viz. Right and left and two additional lobes, caudate and quadrate of being part of right lobe in structural orientation but functionally quadrate solely belong to left lobe, caudate sharing contributions of both principal lobes. Being vascular organ it is richly supplied by two different sources such as hepatic artery and Portal vein at 20 % and 80 % respectively.[1]

MATERIALS AND METHODS

The current study was conducted at the department of Anatomy School of Medical Education of Mahatma Gandhi University Kottyam, Kerala from 1995 to 1997 as the dissertation work required for the partial fulfilment of the Masters Degree of Medical Anatomy affiliated at MG University Kottyam (Accredited by NAAC with A-Grade). In-order to study the Gross Anatomy of Liver the author had carried out the practical / dissection of abdominal region of human body at the dissection Hall of the Institute,for which Cunnigham Manuel of Practical Anatomy Volume -2, Gray's Anatomy-36th Edition were used.[2] The length and breadth of the liver was took by measuring tape and weighing machine. Clinical Highlights of liver was learned from audiovisual aids by Clinical faculty.

RESULTS

The topography of liver was taken on the surface of the cadaver (Table-1). Abdominal cavity was opened by paramedian surgical incision on anterior abdominal wall. The various relations of the liver insitu were ascertained for which the greater sac, greater omentum, lesser omentum, stomach, liver and coils of jejunum and Ilium were exposed. Inferior margin, Anterior and Inferior surfaces with gall bladder, falciform ligaments,

Intraperitoneal sub-phrenic recesses of liver were identified. Assessed the gastric and hepatic connections of lesser omentum inorder to introduce tip of finger for assessing Epiploic foramen of Winslow being communicated grater sac and lesser sac. The contents of free margin of lesser omentum such as hepatic artery, bile duct and Portal vein were exposed. The position of liver was examined with one hand in abdominal cavity and other in the peritoneal cavity and pulled it downwards and divided the superior layer of coronary and left triangular ligaments as well as cut a segment of the Inferior venacava to be took out the liver. We had examined the liver which was soft, dark brown and blunt wedge shaped with rounded base to the right and apex to left. The diaphragmatic surface was divisible into superior, anterior, right and posterior parts which together forms the curved surfaces applied to diaphragm. The anterior and inferior or visceral surface had separated by the distinct sharp inferior border.

The weight, length of surfaces and borders were measured (Table-3). The principal lobes of the liver were right and left which being separated by falciform ligament, fissure for ligament teres and fissure for ligamentum venosum at anterior, inferior and posterior surface respectively. The right lobe had sub-lobulations such as caudate lobe and quadrate lobe placed at posterior and inferior surface respectively. Porta hepatis, the hilum of liver which contains Portal vein, Hepatic artery, Bile duct, nerve plexus and lymphatics. It lies between quadate and quadrate lobe and it had connections with ligamentum venosum and ligamentum teres at its left end. Superior and inferior coronary ligament encloses bare area of liver which being angled at right triangular ligament. Left triangular ligament connects left lobe of liver with diaphragm. Hepatic extensions of the lesser omentum to fissure of ligamentum venosum and porta hepatis as the vertical and horizontal limb respectively.

The hepar being enclosed by peritoneum except at some areas such as bare area, Groove of Inferior venacava, fossa of gall bladder, fissure for ligamentum venosum and fissure of ligamentum teres. The inferior venacava being buried at the deep groove connected to the liver by right, middle left hepatic veins. Anterior surface of body of gallbladder plastered on its fossa but fundus extends beyond the inferior margin at cystic notch which completely enveloped by peritoneum.

Anterior surface contacted with anterior abdominal wall. Posterior surface related with right suprarenal gland, Inferior venacava on right lobe, and abdominal part of oesophagus on left lobe of liver. Superior surface fits under the vault of diaphragm separates base of right lung, left lung with respective pleura and the central tendon separates base of fibrous pericardium with inferior surface of heart at cardiac impression. Right surface associated with Right lung, right costodiaphrgmatic pleural recess and 7 to 11 ribs at upper, middle and lower third respectively. Inferior or visceral surface being irregular in shape to fit the upper abdominal viscera for which right lobe related with right kidney, Hepatic flexure, first part of duodenum, pylorus where as the left lobe lies over anterior surface of stomach except a small part contact with lesser omentum as tuber omentale. Caudate and quadrate lobes had tetralogy relations in which caudate lobe had inferior venacava, ligamentum venosum, superior surface and porta hepatis at right, left, superior and inferior respectively. Quadrate lobe had relations of fissure for ligamentum teres, fossa of Gall bladder, Porta hepatis and inferior margin at left, right, upper and lower respectively.

Owing to the distinctive blood supply which had been comprising of hepatic artery and Portal vein brings 20% and 80% blood to liver respectively. Venous blood would drained by central veins to hepatic veins, ultimately delivered into inferior venaca.

Hepatic nodes, Coeliac nodes, Paracardiac nodes brings lymph to thoracic duct except bare area which sends to right lymphatic duct.

Fig-1: Captures of Liver depicting surfaces with features at A-Inferior & Posterior, B-Anterior, C-Right, D-Superior aspects.

Table-1: Showing the structures visible during dissection of Liver.

Observations of Gross Structure of Liver	
Objectives of Gross structure	**Observations**
Topography	*First point*: Right 10th costal cartilage at midaxillay line *Second point*: Tip of 9th costal cartilage *Third point*: In the median plane where TP plane cut *Fourth point*: Tip of left 8th costal cartilage. *Fifth point*: Left 5th rib at midclavicular line.
Extrahepatic attachments to abdomen	Falciform ligament
Extrahepatic attachments to Diaphragm	Superior and Inferior coronary ligament Right and Left Triangular ligament
Fissures	Ligamentun venosum Ligamentun teres
Intraperitoneal fossae	Right anterior intraperitoneal fossa. Right Posterior intra peritoneal fossa of Morrison Left anterior intraperitoneal fossa Left posterior intraperitoneal fossa/ Lesser sac Right extraperitoneal subdiapharagmatic fossa(Bare area) Left extraperitoneal space
Lobes	Right, Left, Caudate lobe and Quadrate lobe
Non-peritoneal areas	Fossa of Gall bladder, Fissure of ligamentum venosum Fissure for Ligamentum teres Groove of Inferior venacava. Bare area At falciform ligament.
Portahepatis	Hepatic artery, Bile duct and Portal vein, Nerves Lymphatics.

Table-2: Showing Structural and Functional lobulations of Hepar based on attachment of ligaments and drainage of bile by right and left hepatic ducts.

Lobulations of liver		
Anatomical lobe	**Position of line**	**Physiological lobe**
Falciform ligament separates right and left lobe	Anterior surface	Connect plane between cystic notch and IVC /Cystovenacaval (CVP) plane
Fissure for ligamenum venous divides liver into two lobes	Posterior surface	Cystovenacaval plane passes at middle of IVC
Fissure for liamenetum teres demarcate Liver into right and left lobe	Inferior surface	Cystovenacaval plane passes at Middle of Quadrate lobe
Caudate and Quadrate lobe belongs to Right lobe		

Table-3: Exhibiting Hepatic segmentation based on distribution of arterial, bile duct, Portal vein and Hepatic tributary.

Hepatic Segmentations	
Right lobe	**Left lobe**
Right anterior upper, Right Anterior lower Right posterior upper, Right posterior lower	Left medial upper, Left medial lower Left lateral upper, Left lateral lower

Table-4: Showing length of surfaces, borders and weight of liver.

Measurements of Liver				
Length of Surfaces		**Weight**	**Length of Borders**	
Surfaces	**Length**		**Borders**	**Length**
Anterior	11.50cm	01.50kg	Superior	12.00cm
Posterior	05.00cm		Anterior	12.50cm
Superior	05.50cm			
Right	13.00cm		Inferior	26.00cm
Inferior	12.00cm			

DISCUSSION

Owing the study of gross structure of human liver which ascertaining the various feature and measurements which can be used for clinical applications when it deranged. The functions of liver are metabolising the products of digestion, storage of liver glycogen so as to maintain a constant level in blood, synthesis of proteins, degradation of poisonous substances and facilitates digestion by exocrine activity of bile.

Table-7: Showing Analysis of measurements of Human liver Kg-Kilograms, %- Percentage, cm- centimetre, M-Male, F-Female and ND –No data.

Name of Authors	Measurements				
	Weight Kg	Body weight %	Transverse cm	Vertical cm	Antero-posterior cm
H Greys et al	M1.4 - 1.8 F1.2 -1.4	2.5%	ND	ND	ND
G.J Romanes et al	ND	2%	ND	ND	ND
RMH McMin et al	1.5	ND	ND	ND	ND
D.C. Wolf et al	M1.4 - 1.5 F1.2 -1.4	ND	ND	ND	ND
S. Mithra et al	M1.4 - 1.6 F1.2 -1.4	1/36	15-20	17	14
A.K. Dutta et al	M1.4 - 1.8 F1.2 -1.4	1/36	ND	ND	ND
Ranganathan et al	ND	1/50	18	16	14
IB Singh et al	1.5	ND	ND	ND	ND
A Paul et al	-	1/50	ND	ND	ND
A Manoj et al	1.5	ND	17	15	13

The weight of liver in both genders were almost same in the literature of H Greys et al, DC Wolf et al, AK Dutta et al and S Mithra et al.[1,3,4,6,7] Though our study agreed with observations of RMH McMin et al and IB Singh et al but had less differences with other reports.[4,5] In terms of percentage of the body weight the data of H.Greys et and GJ Romanes et al were almost same.[1,2] However the reports of AK Dutta et al and S Mithra et al were same but they could not been agreed others.[6,7] The data of Ranganathan et al and A Paul et al[8,9] were same but it was quite more than other reports. Transverse, Vertical and antero-posterior dimensions were almost same in the observations of S Mithra et al, Ranganathan et al.[7,8] Our study agreed with findings of dimensions of previous reports.

The measurements of surfaces and borders were also made in the current study (Table-2) which can be used for clinical purposes once the organ get disturbed.

Tabel-8: Depicting comparison and Analysis of features of liver.

Name of Authors	Features				
	Anatomical Lobes	Physiological lobe	Segments	Borders	Surfaces
H Greys et al	Right, Left Caudate Quadrate	Distribution of Hepatic ducts	8	Superior Inferior Posterior	Anterior Right Posterior Superior Inferior
G.J Romanes et al	Right, left Caudate Quadrate	Distribution of Portal vein and hepatic artery	ND	Inferior	Diaphragmatic Visceral
RMH McMin et al	Left, Caudate Quadrate Right	Caudate and Quadrate belong to left lobe	4	Inferior	Diaphragmatic Visceral
S. Mithra et al	Right, left Caudate Quadrate Reidel's	Cholecystovenacaval line	ND	Inferior Post.superior Post.inferior	Anterior Superior Rt.Lateral Inferior Posterior

A.K. Dutta et al	Right, left Caudate Quadrate Reidel's	Cholecystovenacaval line	ND	Inferior Post.superior Post.inferior	Parietal Visceral
IB Singh et al	Right, left Caudate Quadrate		9	Inferior	Diaphragmatic Visceral
Ranganathan et al	Right, left Caudate Quadrate Reidel's	Based on hepatic ducts divisions	8	Inferior	Anterior Superior Rt.Lateral Visceral Posterior
A Paul et al	Right, left Caudate Quadrate	ND	ND	Inferior	Anterior Posterior Superior Right Inferior
A Manoj et al	Principal (Right and left) Sublobulation (Caudate Quadrate)	Cystocaval plane	8	Indistinct (Anterior posterior) Sharp (Inferior)	Anterior Superior Posterior Right Inferior

Anatomical lobulation has been based on the attachment of ligaments connected to anterior, posterior and inferior surface, wherein reviewed by authors depicted. However on the superior surface the right layer of falciform ligament forms the superior coronary ligament which angled to form right triangular ligament and continues as inferior layer of coronary ligament which reflects along the right border of caudate lobe. So the point of divergence of falciform ligament took place at the level of inferior venacava. Physiological lobulation of liver has been demarcated by Cholecystovenacaval line based on the distribution of blood which has been documented from authors reviewed in this study. Nonethless, since the imaginary line connecting cystic notch and Inferior venacava we used the term cystovenacaval plane (CVP). Segmentation of hepar is based on the division of right and left hepatic ducts for which Grey's et al, Romanes et al, JE Scandalakis et al Ranganathan et al figured eight segments which was agreed by the current study (Table-3). Neverthless IB Singh et al reported nine segments in which an additional duct had for the caudate lobe. The features of Borders and surfaces has to have similar observation in previous reports and current study.

Among the measurements of the surfaces and borders, right surface had long length and posterior was shortest, inferior border was the longest and superior had only half of it. In hepatomegaly liver enlarges downwards in which the inferior border is more prominent. The knowledge of measurements of surfaces and borders would help the clinician in-order to diagnose the degree of liver diseases.

The non-peritoneal areas of liver are Fissure for ligamentum teres (FLT), ligamentum venosum (FLV), Fossa gall bladder (FGB), Groove for inferior venacava (GIVC) and Porta hepatis (PH) which forms an H-shaped fissure at the centre of posterior and inferior surface of liver. FLT and FLV are clefts which divides right and left lobes at junction between quadrate lobe and caudate lobe at inferior and posterior surface respectively. In the current study FLT and FLV were demarcated by the presence of ligamentum teres hepatis and ligamantum venosum in which both are embryological remnants of left umbilical vein and ductus venosus respectively during foetal circulation.FGB accommodates the gallbladder connected by the attachments of loose areolar tissue in which the peritoneum encapped on its under surface. Our study agrees it,that the gall bladder was firmly connected by loose areolar tissue and under surface of gall bladder was smooth and shiny due to peritoneal covering. GIVC is the part of liver in which hepatic segment of inferior venacava lies hence its floor has been pierced by hepatic veins and if groove has bridged by liver tissue converting the groove into tunnel called Pons hepatis.[7] Our observations were same, but there was no pons hepatis bridging for tunnelling GIVC. PH or the hilum of hepar is the gate way for structures entering and leaving in which Portal vein and Hepatic artery brings blood to the liver accompanied by hepatic plexus of nerves whereas bile duct and lymphatic leaves it. In our study we emphasized the positions of the structures in the porta hepatais and ascertained relations of the ligamentum teres hepatis and ligamentum venosum been the embryological remnants of left umbilical vein and ligamentum venosum being brought blood to the left division of portal vein and bypassed to inferior venacava respectively. To accentuate the positions and its contents of the right limb of the H-fissure at the right of porta hepatis being transferred its secretary products and unstuarated blood to bile duct and inferior venacava respectively. Our study emphasised that the contents of the right limb of the H-fissure were functionable during prenatal life for brining blood to

hepar were as the inferior venacava and bile duct collects the fluids from liver which could be required for homeostasis. Therefore evidence of anatomical division and functional division of liver would be the left and right limbs of H-fissure respectively and horizontal limb being crossbar porta hepatis at the centre which has been receiving and sending their ingredients to appropriate channels inorder to accomplishes its functions.

CONCLUSION

Our study enable the art of dissection of human liver and comprehensive study of its gross structure which imparts knowledge to the medical students as well as Clinicians for identifying the gross structure of liver,its variations and their disorders. Also this study is been governing for correction of the paradoxical aspect of the understanding of hepatic anatomy.

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REFERENCES

1. H.Gray. William Warwick, Churchil Livingston Thirty Sixth Edition 1980, Reprinted, 1986; Liver 1374-1385.
2. CJ Romanes. Cunnigham Manuel of Practical Anatomy, Volume Two Thorax and Abdomen Fifteenth Edition Reprinted 1989, Liver 155-163.
3. DC Wolf. Evaluation of the Size, Shape and Consistency of Liver Ann Intern Med, 1969; 70: 1183-89.
4. J E Skandalakis, LJ Scandalakis, P Mirilas. Hepatic Surgical Anatomy Surg Clin N Am, 2004; 84: 413-435.
5. RMH.McMinn. Last's Anatomy Regional and Applied, Churchill Livingston ELBS edition Reprinted, 1993; Liver 342-351.
6. IB Singh. Text Book of Anatomy with Colour Atlas Third Edition Vol.2 Thorax Abdomen and Pelvis. Jaypee Brothers Medical Publishers Pvt. Ltd First Edition, 1996; Liver 640- 649.
7. S Mithra. Anatomy Abdomen, Thorax and Inferior Extremity, Academic Publishers Kolkata-700073, India, Third Edition Liver 1.72 - 1.81.
8. AK Dutta. Essentials of Human Anatomy, Thorax and Abdomen, Current Book International Third Edition, 1994; Liver 211 - 231.
9. TS Renganathan. A Text book of Human Anatomy S Chand & Company Ltd, Ram Nagar, New Delhi-110055 Eight Edition, 1996; Liver 297 - 305.
10. A Paul. Anatomy Simplified BI Publications, New Delhi First Edition, 1997; Liver 242 - 244.