

A Study on Histological Structure of Human Liver in Different Age Groups

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Abstract

Original Research Article

The structural and functional unit of the liver is the hepatic lobule. Incidence of hepatocellular diseases are increasing day by day and the scope of liver transplantation as well as this being the conclusive treatment procedure in many of these conditions. The structure of hepatic lobules definitely have a very important role in acceptance or rejection of the graft. So, to find out suitable donor, micro structural study of the liver is important to see if there is any change of liver histology in relation to age. So, with the aim to observe and compare the histology of the human liver in different age groups, the study has been undertaken.

Keywords: Histological Structure, hepatocellular diseases, histology.

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INTRODUCTION

The liver is the largest digestive organ. The size of the liver also varies according to sex, age and body size. The size of the liver rapidly increases from infancy to adulthood. This reaches a plateau around 18 years and is followed by a gradual decrease in the liver weight from middle age. The ratio of liver to body weight decreases with growth from infancy to adulthood.

Histology of human liver: In histological section liver exhibit repeating hexagonal units called liver (hepatic) lobule [1]. The classic liver lobule is described as a hexagonal 'cylinder' centered around the efferent terminal branches of the hepatic vein, the so-called central veins of the lobule [17]. The classic hepatic lobule measures about 1.5–2mm long and 1–1.2mm wide. These lobules are surrounded by connective tissue fibers. The connective tissue at the triangular points between several lobules forms a triad known as Glisson triad or Portal Triad or portal areas. Although one would expect to find six portal areas around each classical lobule, usually only three equally distributed portal areas are present in a random section [4, 8]. The hepatic cells are arranged as plates which form the lacunae [19]. The hepatocytes (liver cells) form plates (cellae murales) one cell thick (except in

young children) in whom two-cell thick plates may be seen [18].

Microscopic structure of the liver is important to study whether there is any change or disease. Liver transplant is becoming a very important part of treatment in various liver diseases. Donor could be of any age, usually adult.

MATERIALS AND METHODS

Place of study: Department of Anatomy, Gauhati Medical College, Guwahati, Assam.

Duration: One year.

Sample size: 47 subjects. Specimens were collected from the Department Of Forensic Medicine after fulfilling all required formalities.

Sample preparation method: The whole liver was thoroughly washed in running tap water and then dried with blotting papers. Then 3×5 mm size piece were cut out from the inferior border of the specimen and was preserved in 10% formalin for 24-48 hours.

Verification of the age: from autopsy register book.

Consent: taken from the attendants of the deceased.

Exclusion Criteria

- Cadavers with gross congenital malformations.
- Cadavers with past evidence/record of any pathology of the liver (eg.cirrhosis, malignancy, tuberculosis of the liver etc.)
- Cases where age was doubtful.

The liver specimens were divided into three groups according to different age groups as follows:

Table-1:

Group	No. of Specimens	Age (in years)
1	15	0-14
2	16	15-30
3	16	>30

The tissues were subjected to dehydration by immersing them into ascending strengths of alcohol i.e. 50%, 70%, 90% and absolute alcohol for a specified time. The pieces were immersed into clearing agent xylol for half an hour. Then wax impregnation was done by passing the tissue through liquid paraffin bath, maintained at 60°C temperature. Paraffin blocks were prepared with the help of L-block (Leuckhart's block) washed with glycerin. Melted paraffin was poured into square of appropriate size and tissues were dipped into it from the impregnation bath with hot tipped forceps. The blocks were labeled with small pieces of paper dipped into the block before solidification. Blocks were

solidified by submerging them into cold water bath. This was followed by sectioning and staining of the tissue with Haematoxylin and Eosin stain according to standard methods described by Carleton [20]. The stained sections were examined under both low and high power microscope.

For measurements of diameter and shape of liver lobule, hepatocytes radiating or not fatty changes of the liver, portal triad were looked for. For the diameter that was considered was the mean of two principle diameters at right angle to each other.

Diameter of the liver lobules were calculated with the help of Stage and Eyepiece Micrometer.

The biometrical values were statistically analyzed by standard statistical method. The data were analyzed to calculate the mean and 't'-test was applied to find out the significant difference between the mean values.

The 'p' value is calculated using student's t test probability chart.

RESULTS AND OBSERVATIONS

In this study we have found that the mean diameter of classical lobule of group 1, group 2 and group3 was found to be 1.41 ± 0.234 , 1.72 ± 0.36 , 1.2 ± 0.23 and a total mean of 1.45 ± 0.35 .

Table-2

Group	Range of diameter of hepatic lobule	Mean diameter of hepatic lobule	Standard deviation (SD)	Standard error of mean (SEM)
1	1.1-2.04mm	1.41mm	± 0.234	± 0.061
2	1.1-2.2mm	1.72mm,	± 0.36	± 0.091
3	0.83-1.8mm	1.2mm	± 0.23	± 0.207

During the comparison of mean values of diameter of classical liver lobule between group 1 & 2, the 'p' values was found to be 0.4936 (statistically non significant); between group 2&3, the 'p' value was 0.2363 (statistically non significant) and between group 2&3, the 'p' values was 0.0167 (statistically significant)

Most of the specimens of a) group 1 fell between 1.2-1.3mm of diameter with a frequency of 7, relative frequency of 0.467 and percentage frequency of 46.7%; b) group 3 fell between 1.2-1.3mm with a frequency of 8, relative frequency of 0.5 and percentage frequency of 50%; c) group 2 fell between 1.66-1.7 and 2-2.1mm of diameter with a frequency of 4, relative frequency of 0.25 and percentage frequency of 25%.

In this study, we have found fatty changes in group 3 in two cases, but no atrophy or hypertrophy were noticed.

DISCUSSION

Ageing is the process of becoming older. In humans, ageing represents the accumulation of changes in a human being over time. Age-related causes are the greatest risk factor for most of the human diseases. But we have found two case with fatty changes without any alcoholic history or known liver pathology. Both the case were in group 3. Several studies were done on the hepatic classic lobule and its variation in relation to age like Popper [5], Rappaport [14], Jaiswal *et al.*, [7], Medhi *et al.*, [11], Prentis and Snowden [13], Madhan *et al.*, [9], Horvath *et al.*, [6], Warren *et al.*, [16], McLean *et al.*, [10].

Table-3: Showing the studies with diameter of classical lobule (mm)

Study	Diameter of classical lobule (mm)
Garter & Hiatt (2014) [3]	2
Shennan (1912) [15]	2-3
Datta (2010) [2]	1
Madhan, Raju (2014) [9]	1-2
Present study (2016)	1.45± 0.35

In the present study the diameter of the classical lobule was found to be 1.45±0.35mm. Unpaired 't' test was done to compare the diameter of the classical lobule among group 1, group 2 and group 3, was found to be statistically insignificant.

The result of the present study is comparable with Garter & Hiatt [3], Shennan [15], Datta [2], Madhan and Raju [9] who mentioned in their study that the size of the lobule is 2mm long and 0.7mm in diameter; about 2-3 mm; about 1mm; 1-2mm wide respectively.

SUMMARY

The mean diameter of the classic liver lobule in group 1 is 1.41mm, group 2 is 1.72mm, in group 3 is 1.2mm. The mean diameters of the lobule of the three groups were found to be highest in group 2, intermediate in group 3 and lowest in group 1. No significant intergroup variations were found.

The classic lobules of the liver were noticed as polygonal structure under the microscope and ill-defined connective tissue septa were noticed in between the lobules.

CONCLUSION

In the present study we have not found any significant histological change in relation to diameter of the classical lobules. Atrophy, agenesis, presence of accessory lobes, accessory fissures, well-developed papillary process may mislead the diagnostic procedures. Therefore, the knowledge of these variations may be a fruitful finding for correct interpretation of radiographs, clinicians for the diagnosis as well as surgeons in management of hepatic diseases. The potential effects of old age on the hepatic microcirculation are important because this might influence hepatic function, particularly hepatic clearance, through influencing hepatic perfusion. There is substantial reduction in hepatic clearance of many substrates in old age.

The liver is the only visceral organ that possesses remarkable capacity to regenerate. The liver can regenerate after either surgical removal or after chemical injury. It is known that as little as 25% of the original liver mass can regenerate back to its full size. The process of regeneration in mammals is mainly

compensatory growth because only the mass of the liver is replaced, not the shape. However, in lower species such as fish, both liver size and shape can be replaced.

Liver regeneration involves replication of the liver cells, mainly hepatocytes, followed by other cells such as biliary epithelial cells and sinusoidal endothelial cells. Liver function is only partially affected during liver regeneration e.g. drug metabolism decrease, but albumin and bile production are not substantially affected.

Living donor liver transplantation has emerged in recent decades as a critical surgical option for patients with end stage liver disease. The concept of Living donor liver transplantation is based on the remarkable regenerative capacities of the human liver and the widespread shortage of cadaveric livers for patients awaiting transplant. In Living donor liver transplantation, a piece of healthy liver is surgically removed from a living person and transplanted into a recipient, immediately after the recipient's diseased liver has been entirely removed.

Study like using embryonic porcine liver as a source for transplantation over intact liver implants to overcome homeostatic inhibition by the quiescent host liver. But till now no successful evidence has been found. So, the present study has a scope for the research purpose for future.

This study is a sincere and humble effort to determine the different parameters of the histomorphology of human liver. Since in our study sample size is not adequate due to time constraint, there is a scope of further study to evaluate the histomorphology of liver which will help in liver transplant.

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