Original research article

HARBIN'S INDEX: ASSESSING CAUDATE-TO-RIGHT LOBE RATIO IN HUMAN CADAVERIC LIVER MORPHOLOGY

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Abstract

Introduction: Liver cirrhosis represents the final stage of liver fibrosis, stemming from prolonged injury to the liver. At the microscopic level, it is characterized by the formation of regenerative nodules comprised of hepatocytes, surrounded by fibrotic tissue. This disrupts the normal architecture of the liver, impairing its function. The exchange of blood between the sinusoids and the liver tissue is compromised due to the redirection of portal and arterial blood directly into the hepatic outflow, leading to further dysfunction. Clinically, liver cirrhosis manifests with various complications, including impaired liver function, portal hypertension, and an increased risk of hepatocellular carcinoma. Although a quarter of cirrhotic livers may appear morphologically normal, imaging studies such as computed tomography often reveal widespread atrophy in over a third of cases, along with focal hypertrophy, particularly noticeable in the caudate lobe. This hypertrophy often occurs alongside segmental atrophy of the right lobe. The Caudate lobe to right lobe ratio (C/RL ratio) serves as a crucial morphological measurement to assess the alterations in cirrhotic livers. A globally accepted value for this ratio, typically above 0.65, suggests the presence of liver cirrhosis. Therefore, understanding variations in the C/RL ratio is essential for diagnosing and monitoring the progression of cirrhosis. This study seeks to analyze the morphometric measurements of the right lobe in human cadaveric livers, specifically focusing on the C/RL ratio. By doing so, it aims to establish a baseline dataset against

which future studies can be compared.
Aims and Objectives: To analyze the morphometric measurements of the right lobe and determine the C/RL in human cadaveric liver and compare the values of C/RL ratio to previously documented studies in an attempt to provide baseline data.
Material and Methods: The research was conducted on a sample of 100 human cadaveric livers at the Departments of Anatomy in the three medical colleges-Government Medical College, Srikakulam, Andhra Medical College, Visakhapatnam and Government Medical College Vizianagaram. To ensure accuracy, morphometric measurements were meticulously recorded in millimeters using both threads and a Kristeel digital Vernier Caliper. Excluding 20 specimens showing gross pathological conditions, each liver was carefully positioned to distinguish between its visceral and parietal surfaces. Morphometric measurements were then taken, and Harbin's index (CT/RT) was calculated by determining the ratio of CT (Caudate lobe thickness) to RT (Right lobe thickness). Comprehensive documentation, including photography of the findings, was undertaken. Data analysis involved the use of descriptive statistics to summarize the observed measurements.
Results: The mean transverse diameter of the right lobe was found to be 77 ± 12 mm, with measurements spanning from 55 to 95 mm. Similarly, the longitudinal diameter of the right lobe averaged 128 ± 20 mm, ranging from 90 to 174 mm. Harbin's Index, representing the ratio of the caudate lobe thickness to the right lobe thickness (CT/RT), yielded an average of 0.4 ± 0.14, with values varying between 0.18 and 0.7. These findings provide valuable insights into the morphological characteristics of the cadaveric livers studied, highlighting the variability and range of dimensions observed in this population.
Discussion: The current investigation confirms the established values of the caudate to right lobe ratio in individuals without liver pathology, showcasing a notable contrast when compared to documented cases of liver cirrhosis. These findings suggest that the caudate to right lobe ratio, as measured by Harbin's index, could serve as a highly reliable parameter for the diagnosis of liver cirrhosis and other chronic liver diseases. The clinical significance of evaluating the caudate to right lobe ratio as a diagnostic tool, offering clinicians a valuable means of assessing liver health and identifying underlying liver pathologies.
Keywords: Caudate to right lobe ratio, Harbin's index, liver cirrhosis

Introduction

The liver is a vital intra-abdominal organ located primarily in the right upper abdomen, extending into the central and left upper abdomen. It comprises five distinct surfaces: anterior, superior, right, inferior, and posterior. Anatomically, it is segmented by ligamentum venosum, ligamentum teres, and the falciform ligament into four lobes: the right, left, quadrate, and caudate lobes. The caudate lobe, situated on the posterior surface of the liver, is bounded by the inferior vena cava on its right side and the ligamentum venosum groove on its left. While anatomically classified as part of the right lobe, its physiological function aligns more closely with the left lobe. It stands as a distinct anatomical region within the liver, supplied by its own set of blood vessels, including branches of the portal vein and hepatic artery. Consequently, it may be uniquely affected by vascular-related liver pathologies. The caudate lobe holds

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significant clinical importance in conditions such as metastasis, cirrhosis, and surgical resections. Additionally, alterations in the caudate-to-right lobe ratio are indicative of various liver diseases.

Liver cirrhosis represents the advanced stage of various chronic liver conditions, characterized by irreversible progression leading to liver dysfunction, portal hypertension, and potentially hepatocellular carcinoma. It poses a significant global public health challenge, with its prevalence varying worldwide. Autopsy studies suggest a prevalence ranging from 4.5% to 9.5% in the general population. In the United States, cirrhosis ranks as the twelfth leading cause of both hospitalization and mortality. Particularly in developing nations, cirrhosis contributes substantially to morbidity and mortality rates [1-5].

Hepatitis stands out as one of the primary culprits behind chronic liver diseases globally, affecting a considerable portion of the population. Its impact remains pervasive and significant across diverse regions.

Cirrhosis stands as a prominent contributor to global mortality and morbidity. It ranks as the 11th leading cause of death and the 15th leading cause of morbidity, comprising 2.2% of total deaths and 1.5% of disability-adjusted life years globally in 2016. In 2017 alone, chronic liver disease (CLD) resulted in approximately 1.32 million deaths, with around two-thirds occurring in men and one-third in women [6, 7].

Roughly one-fifth of acute hepatitis C cases progress to cirrhosis, a condition often accompanied by complications such as ascites, encephalopathy, and abnormal liver function tests. In such cases, liver transplantation becomes a necessary consideration. The prevalence of non-alcoholic fatty liver disease (NAFLD) is on the rise, mirroring the increasing rates of obesity in Asia. Recent estimates suggest that NAFLD affects approximately 29.6% of the population in Asia, potentially surpassing its prevalence in Western populations. NAFLD prevalence tends to increase with age and is strongly correlated with the presence of metabolic syndrome [8]. Therefore, a comprehensive understanding of liver anatomy and its variations becomes crucial for ensuring successful surgical outcomes, particularly in the modern age of diagnostic imaging and minimally invasive procedures.

Liver cirrhosis represents the advanced stage of liver fibrosis, stemming from prolonged liver injury and subsequent aberrant wound healing processes. Histologically, cirrhosis is characterized by regenerative nodules of hepatocytes surrounded by fibrotic septa, lacking a central vein. This architectural distortion disrupts the normal exchange between hepatic sinusoids and parenchymal cells. Consequently, portal and arterial blood bypass the sinusoids, leading to impaired liver function, portal hypertension, and an increased risk of hepatocellular carcinoma. Currently, liver biopsy remains the gold standard for diagnosing cirrhosis. However, challenges such as sampling errors, incomplete interpretation of histological scores, and the difficulty in identifying advanced stages of cirrhosis in biopsy specimens pose significant diagnostic hurdles.

Conversely, despite approximately one-fourth of end-stage cirrhotic livers appearing morphologically normal in size and configuration, computerized tomography reveals that over one-third exhibit diffuse atrophy. Additionally, nearly half of these livers demonstrate focal hypertrophy, most frequently observed in the caudate lobe alongside segmental atrophy of the right lobe.

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Anatomically, the caudate lobe is identifiable on the liver as a prominence located on its inferior and posterior surfaces. Positioned posterior to the porta hepatis, it is bordered by the fissure for the ligamentum venosum on the left and the groove for the inferior vena cava on the right. Functionally, due to its distinct distribution of portal venous branches and the positioning of hepatic veins within the parenchyma, it functions as a separate lobe and corresponds to segment I in Couinaud's division of the liver into eight functional segments. The caudate lobe to right lobe ratio (C/RL) serves as a morphological measurement to assess hepatic changes in cirrhotic livers. Globally accepted values of the C/RL ratio ranging up to 0.65 may indicate the presence of liver cirrhosis.

Aims & Objectives

The objective of this study is to analyze the morphometric measurements of the right lobe and determine the C/RL ratio in human cadaveric livers. By comparing these values to previously documented studies, the aim is to establish baseline data for future reference.

Material and Methods

The study was conducted using a sample of 100 human cadaveric livers obtained from the Anatomy Departments of three medical colleges: Government Medical College, Srikakulam; Andhra Medical College, Visakhapatnam; and Government Medical College, Vizianagaram. To ensure precision, morphometric measurements were meticulously recorded in millimeters using both threads and a Kristeel digital Vernier Caliper. Twenty specimens exhibiting gross pathological conditions were excluded from the analysis. Each liver was carefully positioned to distinguish between its visceral and parietal surfaces, and morphometric measurements were then taken. Harbin's index (CT/RT) was calculated by determining the ratio of CT (Caudate lobe thickness) to RT (Right lobe thickness). Comprehensive documentation, including photography of the findings, was carried out. Data analysis involved the use of descriptive statistics to summarize the observed measurements.

Cadavers preserved using formalin-based embalming fluid were dissected during anatomy practical classes to extract the liver en bloc, including the hepatic segment of the inferior vena cava and structures within the porta hepatis. Nineteen specimens exhibiting gross pathological conditions were excluded from the study. Each liver was positioned anatomically to distinguish between its visceral and parietal surfaces, and morphometric measurements were recorded in millimeters using cotton threads and a Kristeel digital Vernier Caliper calibrated to 200 mm/8 inches (2917).

Harbin’s Index C T/RL

Harbin's Index, denoted as CT/RL, was calculated using specific anatomical landmarks. Firstly, a line (line 1) was drawn through the right lateral wall of the main portal vein (MPV). Then, another line (line 2) was drawn parallel to line 1 at the most medial aspect of the caudate lobe. Finally, a third line (line 3) was drawn perpendicular to lines 1 and 2, midway between the MPV and the inferior vena cava (IVC), extending out to the lateral margin of the right lobe. The transverse diameter of the caudate lobe (CT) was measured along line 3, between lines 1 and 2, representing Harbin's measurement

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A. The right lobe diameter (RL) was measured along line 3, between the lateral margin of the right lobe and line 1, corresponding to Harbin's measurement X. This method allowed for the calculation of Harbin's Index, providing a quantitative assessment of the relationship between the caudate lobe and the right lobe of the liver.

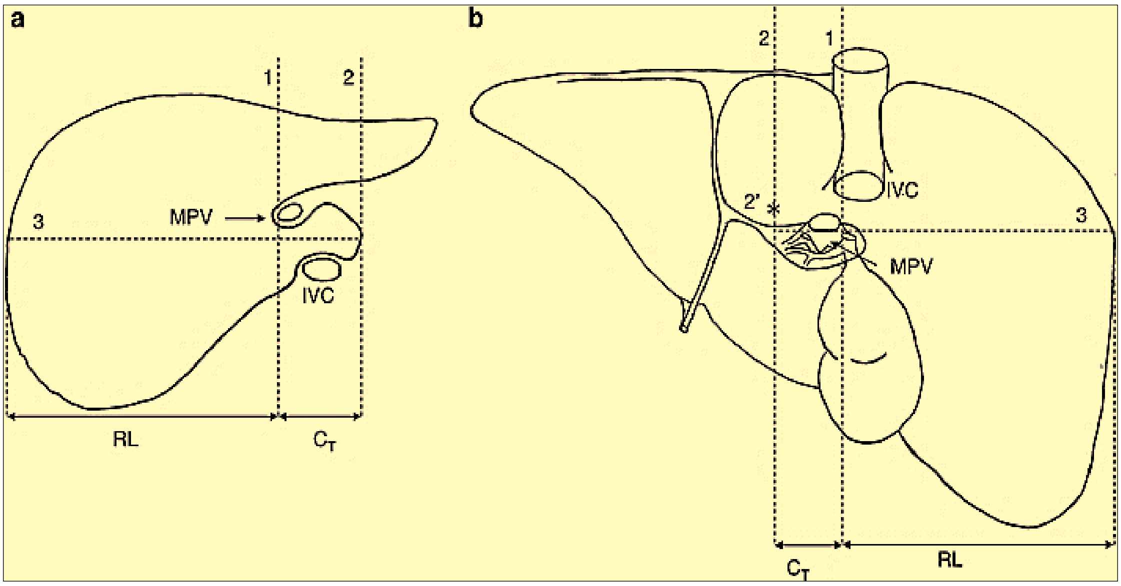

Fig 1: Illustrates the original landmarks

In the schematic drawings of the liver depicting landmarks for the caudate to right lobe ratio (CT/RL):

a) A transverse section of the liver, adapted from Harbin *et al*. (1980) Fig. 1, illustrates the original landmarks used by Harbin and colleagues. These landmarks are drawn through the porta hepatis, specifically at the branching point of the right portal vein from the main portal vein.

b) The visceral surface of the liver is shown in another schematic drawing, highlighting the adapted landmarks utilized in the present study. These adapted landmarks are modified versions of those used by Harbin *et al*., providing a visual representation of the methodology employed in determining the caudate to right lobe ratio.

The process for determining the caudate to right lobe ratio (CT/RL) involves the following steps:

1. The first line (1) is drawn at the level of the right lateral margin of the main portal vein (MPV), running parallel to the midsagittal plane.
2. A second line (2) is drawn at the level of the most medial part of the caudate lobe. The asterisk labelled 2′ indicates the exact point on the caudate lobe's medial aspect through which line 2 is drawn.
3. A third line (3) is drawn perpendicular to the first two lines, extending to the most lateral margin of the right lobe. This line helps determine the diameter of the right lobe (RL) and the transverse diameter of the caudate lobe (CT).

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By measuring these diameters, the ratio of CT/RL can be calculated, providing valuable information about the relative sizes of the caudate lobe and the right lobe of the liver. The inferior vena cava (IVC) is also depicted for reference.
The methodology for obtaining the measurements used in the study is detailed as follows:

- The transverse diameter of the caudate lobe (CT) was determined by measuring the distance along line 3, between lines 1 and 2. This measurement represents the distance from the most medial margin of the caudate lobe to the right lateral wall of the portal vein.
- The transverse diameter of the right lobe (RT) was obtained by measuring the distance along line 3, between the lateral margin of the right lobe and line 1. This measurement represents the distance from the right lateral wall of the portal vein to the most lateral margin of the right lobe.
- Additionally, the longitudinal diameter of the caudate lobe (CL) was measured as the maximum longitudinal extension of the caudate lobe from its inferior border just above the porta hepatis.
- Similarly, the longitudinal diameter of the right lobe (RL) was determined by measuring its vertical length, using the midpoint of the RT as the reference point.

Harbin's index (CT/RT) was then calculated as the ratio of CT to RT. All hepatic measurements were performed by the principal investigator on three separate occasions, and the average of these readings was utilized for analysis.

Statistical analysis: The collected findings were thoroughly documented and photographed. Data analysis was conducted using descriptive statistics to summarize the observed measurements. Additionally, the Shapiro-Wilk test was employed to assess any deviations from normality in the dataset. This statistical test helps determine whether the data follows a normal distribution, which is important for selecting appropriate further analyses and drawing valid conclusions from the data.

Results

The study yielded the following findings regarding the morphological characteristics of the cadaveric livers:

1) The mean transverse diameter of the right lobe was 77 ± 12 mm, with measurements ranging from 55 to 95 mm. Additionally, the longitudinal diameter of the right lobe averaged 128 ± 20 mm, with measurements ranging from 90 to 174 mm.
2) Harbin’s Index, representing the ratio of the caudate lobe thickness to the right lobe thickness (CT/RT), had an average value of 0.4 ± 0.14, ranging from 0.18 to 0.7.

These findings offer valuable insights into the variability and range of dimensions observed in the cadaveric livers studied.
Regarding the morphometric analysis of the caudate lobe:

- The transverse diameter was reported to be 28 ± 7 mm, while the longitudinal diameter was 55 ± 10.2 mm, as discussed in another paper by the same author.

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For the right lobe:

- The transverse diameter (RT) had an average of 77 ± 12 mm, with values ranging from 55 to 95 mm and a median value of 82 mm.
- The longitudinal diameter (RL) had an average of 128 ± 20 mm, with values ranging from 90 to 174 mm and a median value of 126.54 mm.

The Shapiro-Wilk test revealed normal distribution for both the transverse diameter of the right lobe (RT) and the longitudinal diameter of the right lobe (RL). The calculated p-values were 0.001 and 0.02, respectively.

Harbin's index

The measurement of Harbin's Index for each specimen involved calculating the ratio of CT to RT. The derived average value for Harbin's Index was 0.4 ± 0.14, with values ranging between 0.18 and 0.7, and a median value of 0.42. However, the Shapiro-Wilk test indicated that Harbin's Index was not normally distributed, with a p-value of 0.001. This suggests that the distribution of Harbin's Index values deviates from a normal distribution pattern. Harbin's index values for other studies are described in Table 1.

Table 1: Harbin's index values

Study	**Present study**	**Sahni *et al.* [9]**		**Ahidjo *et al.* [10]**		**Chavan and Wabale [4]**	**Arora *et al.* [11]**	**Sagoo *et al.* [5]**	
Sample size	100	138	62	42	62	50	36	50	25
Population	-	Males	Females	Males	Females	-	-	NWI	UKC
Harbin's index (CT/RT)	0.4 ± 0.14	0.31±0.06	0.21±0.07	0.39±0.08	0.38±0.07	0.32	0.16	0.34±0.15	0.27±0.1

CT: Transverse diameters of caudate lobe, RT: Transverse diameters of right lobe, NWI: North‐ West Indian, UKC: United Kingdom Caucasian

The comparison of Harbin's Index (CT/RT) values across various studies reveals notable discrepancies in liver morphology assessments. In the present study involving 100 subjects, the average Harbin's Index was determined to be 0.4 ± 0.14, although the specific population was not specified. Contrarily, Sahni *et al*. reported a slightly lower index of 0.31 ± 0.06 among 138 male subjects. Ahidjo *et al*. focused on males as well, reporting a higher index of 0.39 ± 0.08, although the sample size was not provided. Chavan and Wabale's study, comprising 42 subjects without specified demographics, yielded an index of 0.32. Arora *et al*. presented a considerably lower index of 0.16, though details regarding sample size and population were omitted. Sagoo *et al*., with 50 subjects from an unspecified population, reported an index of 0.34 ± 0.15. These variations underscore the influence of factors such as gender, sample size, and geographic location on liver morphology assessments and emphasize the necessity for further research elucidating these disparities.

Following are the comparative values of Harbin's index in control groups and known cases of cirrhosis.

Table 2: Comparison Harbin's index in known cirrhosis and control group

Study	**Present study**	**Harbin *et al.* [12]**	**Hess *et al.* [13]**		**Giorgio *et al.* [14]**	**Ilione *et al.* [15]**	
Sample size	100	25	58	75	103	107	107
Group	Control	Cirrhosis	Cirrhosis	Control	Cirrhosis	Control	Cirrhosis
Harbin's index (CT/RT)	0.4 ± 0.14	0.83±0.20	0.61±0.25	0.31±1.3	0.62±0.18	0.44±0.00	0.72±0.06

CT: Caudate lobe, RT: Right lobe.

The provided table compares Harbin's Index (CT/RT) values across several studies, including the present study and those by Harbin *et al*., Hess *et al*., Giorgio *et al*., and Ilione *et al*. Here's a concise interpretation of the data: In the present study, which included 100 subjects, the average Harbin's Index was 0.4 ± 0.14, representing the control group. Harbin *et al*. reported a substantially higher index of 0.83 ± 0.20 among 25 subjects with cirrhosis. Similarly, Hess *et al*. found a notable index of 0.61 ± 0.25 in their study involving 58 cirrhosis patients. On the other hand, Giorgio *et al*. observed a lower index of 0.31 ± 1.3 in their control group of 75 subjects. In contrast, among 103 cirrhosis patients, their index was relatively higher at 0.62 ± 0.18. Ilione *et al*. reported a control group index of 0.44 ± 0.00 in 107 subjects and a higher index of 0.72 ± 0.06 among 107 cirrhosis patients. These findings illustrate the variability in Harbin's Index across different study populations, highlighting its potential utility as a diagnostic marker for liver cirrhosis.

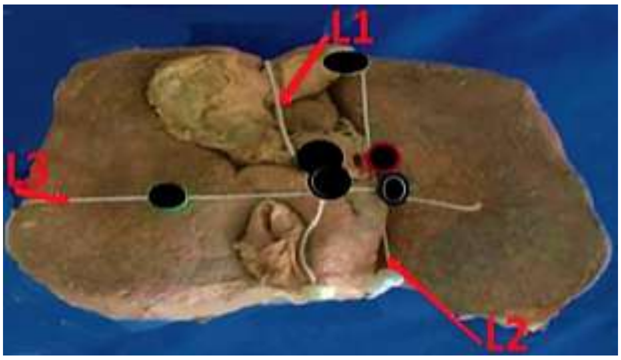

Fig 2: The method for measuring Harbin's Index involves three lines

1. The first line (L1) is drawn through the right lateral wall of the main portal vein.
2. A second line (L2) is marked parallel to L1 at the most medial margin of the caudate lobe.
3. A third line (L3) is marked perpendicular to the first two lines. It extends from the midpoint between the main portal vein and the inferior vena cava out to the most lateral margin of the right lobe.

These lines are essential for accurately measuring the transverse diameters of both the caudate lobe and the right lobe of the liver, allowing for the calculation of Harbin's Index, which represents the ratio of caudate lobe thickness to right lobe thickness.

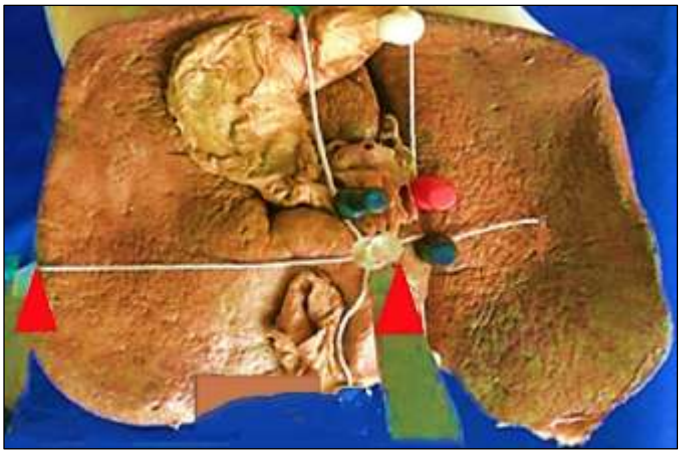

Fig 3: The transverse diameter of the right lobe is measured along line L3, extending from L1 (the right lateral wall of the main portal vein) to the most lateral margin of the right lobe of the liver. This measurement provides crucial information about the width or breadth of the right lobe, which is essential for assessing liver morphology and proportions, particularly in the context of studies involving Harbin's Index or other liver-related investigations

Discussion

The calculation of Harbin's index (CT/RT) involved determining the ratio of the transverse diameter of the caudate lobe (CT) to the transverse diameter of the right lobe (RT). These measurements were taken by the principal investigator on three separate occasions to ensure accuracy, and the average of the readings was used for computation. Subsequently, the findings were thoroughly documented, photographed, and subjected to data analysis using descriptive statistics. Additionally, the Shapiro-Wilk test was employed to assess any deviations from the expected distribution, ensuring the reliability of the results obtained from the study.

The present study observed morphometric measurements of the caudate lobe, and it was noted that the literature lacks sufficient discussion on the relationship between the caudate lobe and the interior of the liver. This gap was addressed by a hypothesis proposed by Dodds *et al*., [16] which suggests that during the second trimester of fetal development, as the liver enlarges, it and the mesentery of the ductus venosus rotate towards the right around and behind the mesentery of the ductus venosus. This rotation results in a small portion of the liver being wedged behind the mesentery of the ductus venosus, within an angle formed by the ductus venosus and the inferior vena cava. This hypothesis sheds light on the developmental process and anatomical relationships within the liver during fetal development, offering valuable insights into the formation and positioning of the caudate lobe within the liver structure. The clarification provided elucidates that the caudate lobe originates from a small portion of both hepatic lobes during development. Consequently, its vascular supply derives from both the right and left hepatic arteries, as well as both portal veins. Additionally, there are small

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communicating veins that directly link the caudate lobe to the inferior vena cava. Becker *et al.* [17] further explain that because emissary veins directly draining into the inferior vena cava maintain the venous drainage of the caudate lobe, any obstruction of the hepatic vein results in increased blood flow through the caudate lobe. This increased blood flow often leads to hypertrophy of the caudate lobe, which may be accompanied by atrophy of the right or left hepatic lobes, a phenomenon frequently observed in cases of cirrhosis.

The study revealed important morphometric measurements of cadaveric livers, shedding light on their anatomical characteristics. Specifically, the mean transverse diameter of the right lobe was determined to be 77 ± 12 mm, with individual measurements ranging from 55 to 95 mm. Similarly, the longitudinal diameter of the right lobe averaged 128 ± 20 mm, with measurements spanning from 90 to 174 mm. Harbin's Index, indicating the ratio of caudate lobe thickness to right lobe thickness (CT/RT), yielded an average value of 0.4 ± 0.14, with variations observed between 0.18 and 0.7. These findings provide valuable insights into the variability and range of dimensions observed in the population of cadaveric livers studied. Additionally, a separate analysis of the caudate lobe revealed a transverse diameter of 28 ± 7 mm and a longitudinal diameter of 55 ± 10.2 mm. In contrast, the average transverse diameter of the right lobe was consistent with that of the caudate lobe, averaging 77 ± 12 mm. These findings contribute to our understanding of liver morphology and provide essential data for future anatomical and clinical studies. The longitudinal diameter of the right lobe (RL) was determined to have an average measurement of 128 ± 20 mm, with individual values ranging from 90 to 174 mm. The median value was calculated to be 126.54 mm. Additionally, the Shapiro-Wilk test was employed to assess the distribution of measurements for both the transverse diameter (RT) and the longitudinal diameter (RL) of the right lobe. The test revealed normal distribution for both parameters, with calculated p-values of 0.001 for the transverse diameter and 0.02 for the longitudinal diameter. These results suggest that the measurements of both the transverse and longitudinal diameters of the right lobe conform to a normal distribution, enhancing the reliability of the data obtained in the study.

The study measured Harbin's Index by calculating the ratio of the transverse diameter of the caudate lobe (CT) to the transverse diameter of the right lobe (RT). The average value obtained for Harbin's Index was 0.4 ± 0.14, with a median value of 0.42. However, the Shapiro-Wilk test indicated that the distribution of Harbin's Index values was not normal, with a calculated p-value of 0.001.

Regarding the morphology of the right lobe, measurements were conducted using the method described by Harbin *et al.* (1980). The average transverse diameter of the right lobe (RT) was found to be 77 ± 12 mm, while the average longitudinal diameter (RL) was 128 ± 20 mm. Sahni *et al.* [9] also reported similar findings, with average RT values of 88.3 ± 13.2 mm in males and 81.8 ± 12.3 mm in females, based on autopsied liver specimens preserved in formalin. These results contribute to our understanding of the morphological characteristics of the right lobe of the liver and provide valuable comparative data from previous studies.

In a radiographic study conducted on adult healthy volunteers at the College of Medical Sciences, University of Maiduguri, Borno, Ahidjo *et al.* found that the mean ± standard deviation for the transverse diameter of the right lobe (RT) was 88.7 ± 12.6 mm in

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males and 83.6 ± 10.4 mm in females, with respective ranges of 62-110 mm and 62-108 mm. Chavan and Wabale examined 50 embalmed livers at RMC, Loni, and reported the average transverse diameter of the right lobe (RT) as 84 mm, with a range of 67-105 mm. In another study conducted on embalmed livers at Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Arora *et al*. measured the average transverse diameter of the right lobe (RT) as 77.9 mm, ranging from 52.9 to 99.3 mm, and the longitudinal diameter (vertical length) of the right lobe as 114.3 mm, with a range of 95.2-136.3 mm.

Sagoo *et al*., [5] in a similar study on embalmed livers from two different populations, North West Indian (NWI) and the United Kingdom Caucasian, derived average transverse diameters of the right lobe (RT) as 80.6 ± 10.16 mm and 88.2 ± 10.9 mm, respectively. In the present study, Harbin's index, calculated as the ratio of the transverse diameter of the caudate lobe (CT) to the transverse diameter of the right lobe (RT), was determined to be 0.4 ± 0.14. This index serves as a crucial indicator, particularly in identifying pathological changes within the liver, such as nodular regeneration or hypertrophy, which may be challenging to detect solely through ultrasonography. Notably, caudate lobe hypertrophy often correlates with liver cirrhosis or other chronic liver diseases, highlighting its clinical significance. Understanding normal morphometric measurements in healthy adult subjects is essential for detecting any deviations indicative of underlying pathology. Harbin *et al*. initially calculated hepatic indices using ultrasonography on in situ liver specimens. While the same points could be identified on livers dissected from cadavers embalmed with formalin, a question arises regarding the applicability of ultrasonographic measurements from living patients to embalmed tissue without modification. Studies by Rutherford and Karanjia [18] and Nlebedum *et al*. [19] demonstrated minimal shrinkage effects on liver tissue following embalming, suggesting that although there may be some distortion in microscopic architecture, the overall morphology of hepatocytes and Kupffer cells remains relatively unchanged. This insight underscores the importance of considering the comparability and reliability of measurements obtained from embalmed cadaveric tissue when extrapolating findings to living patients. In Ibrahim H's study [20], the caudate to right lobe (CRL) ratio was reported as 0.30, mirroring the findings of the present study. However, mean values for other parameters, such as vertical thickness (VT), transverse diameter (TD), and diameter of the right lobe, were slightly higher compared to the present study, with values of 57.45±4.74 mm, 27.49±2.82 mm, and 90.58±7.76 mm, respectively. These variations in measurements may stem from differences in study populations, methodologies, or anatomical variations among subjects.

To further contextualize the findings, the current study compared its results with similar studies conducted in various settings and regions. This comparative analysis serves to validate and contextualize the observed morphometric measurements, providing valuable insights into the consistency or variability of liver anatomy across different populations or study cohorts. Such comparisons contribute to a broader understanding of liver morphology and aid in establishing normative values for clinical and anatomical reference.

The quality preservation observed in cadaveric liver samples, including the central vein, portal triad, covering capsule, and vasculature, particularly the sinusoids, can be

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attributed to the liver's profuse vascularity, as embalming fluids were administered through vessels. This meticulous preservation underscores the reliability of cadaveric liver specimens for anatomical and pathological studies.

Conclusion

In conclusion, the present study reaffirms the normal values of the caudate to right lobe ratio in healthy subjects and highlights a significant difference in these values when compared to known cases of liver cirrhosis. These findings suggest that the caudate to right lobe ratio, also known as Harbin's index, can serve as a highly reliable parameter for diagnosing liver cirrhosis and other chronic liver diseases. This parameter holds promise as a valuable tool in clinical practice for the early detection and management of liver pathologies, contributing to improved patient outcomes and healthcare decision-making.

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