

Morphometric Study of Caudate Lobe of Liver.

Neel Kamal Arora¹, Stuti Srivastava², Mahboobul Haque³, Abeer Zubair Khan², Karamvir Singh²

¹Professor and Head, Department of Anatomy, SRMS-IMS, Bareilly.

²Junior Resident, Department of Anatomy, SRMS-IMS, Bareilly.

³Associate Professor, Department of Anatomy, SRMS-IMS, Bareilly.

ABSTRACT

Background: To study the morphology of the caudate lobe of liver. The caudate lobe is visible on the posterior surface, bounded on the left by the fissure for the ligamentum venosum, below by the porta hepatis and on the right by the groove for the inferior vena cava. Above, it continues into the superior surface on the right of the upper end of the fissure for the ligamentum venosum. Below and to the right, it is connected to the right lobe by a narrow caudate process, which is immediately behind the porta hepatis and above the epiploic foramen. Below and to the left, the caudate lobe has a small rounded papillary process. Taking into consideration clinical importance of this lobe in metastasis, cirrhosis and hepatic resections a morphological study was carried out on caudate lobe. **Methods:** This study was undertaken on 36 cadaveric livers available in the Department of Anatomy of Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly to study the morphometry of caudate lobe of liver using vernier caliper. **Results:** Various shapes of the caudate lobe were observed, rectangular being the commonest. **Conclusion:** Knowledge of variations of caudate lobe may be important to anatomists and morphologists for new variant, embryologists for new developmental defect, clinicians for diseases, surgeons for planning surgery involving liver, and imagery specialists for avoiding misinterpretation of CT and MRI.

Keywords: caudate lobe, caudate process, inferior vena cava, papillary process, porta hepatis.

INTRODUCTION

The liver is the largest of the abdominal viscera, occupying a substantial portion of the upper abdominal cavity. It occupies most of the right hypochondrium and epigastrium, and frequently extends into the left hypochondrium as far as the left lateral line. As the body grows from infancy to adulthood the liver rapidly increases in size. This period of growth reaches a plateau around 18 years and is followed by a gradual decrease in the weight from middle age. The ratio of liver to body weight decreases with growth from infancy to adulthood. The liver weighs approximately 5% of the body weight in infancy and it decreases to approximately 2% in adulthood. It performs a wide range of metabolic activities required for homeostasis, nutrition and immune defense. It is an important site of haemopoiesis in the fetus. Conventionally, the liver has been considered to be divided into right, left, caudate and quadrate lobes by the surface peritoneal and ligaments attachments.^[1]

venosum. Below and to the right, it is connected to the right lobe by a narrow caudate process, which is immediately behind the porta hepatis and above the epiploic foramen. Below and to the left, the caudate lobe has a small rounded papillary process. In gross anatomical descriptions this lobe is said to arise from the right lobe, but it is functionally separate.^[1] Dodds et al., hypothesized that during second trimester the ductus venosus rotates rightward as the liver enlarges, so that a small portion of the liver become inserted behind the mesentery for the ductus venosus. This part of liver gives rise to caudate lobe of liver.^[2]

The caudate lobe indeed is an independent anatomical region in liver, making it relatively safe from many of the afflictions of the liver. It also has separate blood supply and biliary drainage. It has great clinical significance due to its paradoxical behavior with respect to rest of the liver in cirrhosis.

The aim of this study was to study morphology and variations of caudate lobe to aid radiologists and surgeons for better interpretation and intervention.

Name & Address of Corresponding Author

Dr. Stuti Srivastava
Junior Resident,
Department of Anatomy,
SRMIS-IMS,
Bareilly, India.
E mail: stutisrivastavaa@gmail.com

MATERIALS AND METHODS

The study was carried out on 36 adult cadaveric livers available in the Department of Anatomy, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly. Livers were removed en bloc from the cadavers along with intra-hepatic part of inferior vena cava and structures in the lesser omentum. Livers with macroscopic evidences of disease were excluded from the study.

Anatomy of the caudate lobe was studied after defining and cleaning lesser omentum covering its two of the four margins. Independence of caudate

lobe is established because of its boundaries. Inferior vena cava and ligamentum venosum determine its transverse extent and porta hepatis with portal vein determine its vertical extent. Hence, mid-point of inferior vena cava was taken as reference point in determining the width of caudate lobe and portal vein to determine length of the lobe.

Absence and shape of caudate lobe, presence of papillary and caudate process, vertical fissure extending upwards from the lower border of the caudate lobe, caudate isthmus and accessory caudate lobe were noted.

The following measurements of caudate lobe and right lobe of liver were taken using vernier caliper. 3 readings of each parameter were taken, out of which maximum was taken into account.

1. The maximum transverse dimension of caudate lobe was measured [Figure 1].



Figure 1: Transverse diameter of caudate lobe.

2. The vertical extent [Figure 2] was measured as the maximum vertical height from the inferior border of the caudate lobe just above the porta hepatis.



Figure 2: Vertical length of the caudate lobe.

3. The transverse dimension of right lobe of liver [Figure 3] was taken from right margin of the portal vein in the porta hepatis.



Figure 3: Transverse diameter of the right lobe of liver.

4. Vertical length [Figure 4 and 5] was determined by taking mid-point of the transverse diameter as the reference.



Figure 4: Vertical length of the right lobe of liver



Figure 5: Vertical length of the right lobe of liver

5. The areas of caudate and right lobes were calculated by drawing the outline on a butter paper. These impressions were traced and measured by counting the number of squares on a graph paper. Their ratio was then determined.

All findings were documented, photographed and compared with the findings of previous authors.

RESULTS

The caudate lobe showed a wide range of variations. Caudate lobe was present in all 36 specimens of liver out of which, 33 specimens showed rectangular shape (91.66%), [Figure 6], 2

triangular (5.55%), [Figure 7] and 1 columnar (2.77%), [Figure 8]. In 5 specimens, papillary process was present [Figure 9]. Vertical fissure extending upwards from the inferior border of the caudate lobe was seen in 7 specimens (19.44%), [Figure 10]. In all the specimens, caudate process was present whereas caudate isthmus and accessory caudate lobe were absent.

[Table 1] shows various measurements. The vertical length of the caudate lobe [Figure 2] ranged between 3.38-7.03 cm (Average 5.03 cm) and maximum transverse diameter [Figure 1] ranged between 1.2-4.24 cm. (Average 2.70 cm). The vertical length of the right lobe [Figure 4 and 5] ranged between 9.52- 13.63 cm (Average 7.79 cm) and transverse diameter [Figure 3] measured from the right lateral wall of the main portal vein ranged between 5.29-9.93 cm (Average 11.43 cm). Area of caudate lobe ranged between 6.84-29.81 sq.cm (Average 13.86 sq.cm) and of right lobe ranged between 60.56-121.44 sq.cm (Average 88.95 sq.cm). The ratio of the two ranged 0.07-0.29 (Average 0.16). The ratio of transverse diameter of caudate lobe to right lobe 0.15-0.58 (Average 0.36).



Figure 6: Quadrangular.



Figure 7: Triangular.



Figure 8: Columnar.



Figure 9: Papillary process.



Figure 10: Vertical fissure extending upwards from the inferior border of the caudate lobe.

DISCUSSION

In the present study, caudate lobe was present in all the 36 specimens as also reported by Joshi et al.^[3] However, Aktan et al^[4] observed an absence of the caudate lobe with 7.41% of the 54 livers studied. Various shapes of the caudate lobe were encountered. 33 specimens showed rectangular shape (91.66%), 2 were triangular (5.55%) and 1 was elongated (2.77%). Out of 90 specimens studied by Joshi et al^[3] 58% rectangular, 20% bicornuate, and rest 22% (20 specimens had different shapes, i.e. pear-shaped, quadrate, triangular, elongated, heart-shaped, square and inverted pear-shaped). Sahni et al^[5] studied 200 specimens and reported that 189 (94.5%) were rectangular, 9(4.5%) pyriform and 2 (1%) irregular. Nayak^[6] reported an abnormal, dumb-bell like caudate lobe in one liver (1.81%). Chavan and Wabale^[7] reported that 24 specimens had a rectangular shape (48%), 13 pear shaped (26%), 7 oval (14%), 3 (6%) square, 2 (4%) triangular and 1 (2%) inverted flask shaped. The reason for this difference may be due to the different set of population under study [Table 2]. Joshi et al^[3] reported prominent papillary process in 32%. Sahni et al^[5] reported presence of papillary process in 67 (33.5%) specimens on the inferior surface near the left anterior angle. Auh et al^[8] observed that on computed tomography, a normal-sized or small papillary process may be mistaken for enlarged porta hepatis nodes. An enlarged papillary process may mimic a

Table 1: Various Measurements.

Measurements	Range	Average
Vertical length of caudate lobe	3.38 - 7.03 cm	5.03 cm
Maximum transverse diameter of caudate lobe	1.2 - 4.24 cm	2.70 cm
Vertical length of right lobe	9.52 - 13.63 cm	7.79 cm
Transverse diameter of right lobe	5.29 - 9.93 cm	11.43 cm
Area of caudate lobe	6.84 - 29.81 cm ²	13.86 cm ²
Area of right lobe	60.56 - 121.44 cm ²	88.95 cm ²
Ratio of caudate to right lobe	0.07-0.29	0.16

Table 2: Various Measurements.

Shape	Sahani et al ⁵	Joshi et al ³	Chavan et al ⁷	Nayak ⁶	Present study
Rectangular	94.5%	58%	48%	-	91.66%
Triangular	-	22%	4%	-	5.55%
Elongated	-		-	-	2.77%
Pear	4.5%		26%	-	-
Inverted flask	-		2%	-	-
Heart shaped	-		-	-	-
Square	-		6%	-	-
Bicornuate	-	20%	-	-	-
Irregular	1%	-	-	-	-
Oval	-	-	14%	-	-
Dumb-bell	-	-	-	1.81%	-

pancreatic body mass, if it extends so far to the left that it displaces the body of the stomach anteriorly. Chavan and Wabale^[7] reported the absence of papillary process in all 50 cases of their study. Nayak⁶ reported that the papillary process of the caudate lobe was very large in one liver (1.81%). Singh^[9] reported that there was a very prominent papillary process continuing with the caudate process as a border indicating overdevelopment of this part of liver. In this present study, the presence of papillary process was seen in 5 specimens.

From the right anterior angle of the caudate lobe, the caudate process extends anteriorly and to the right where hepatic tissue of the caudate lobe merges with the right lobe of liver. Depending upon the position of the fissure on its left at its commencement, its base could be broad or narrow. In the present study, the caudate process was present between the porta hepatis anteriorly and the fossa for the inferior vena cava posteriorly. Sahni et al^[5] found that the caudate process was present in 119 (59.5%) specimens. The present study shows presence of caudate process in all the 36 specimens.

Vertical fissure extending upwards from the inferior border of the caudate lobe was seen in 7

specimens (19.44%) whereas Joshi et al^[3] reported an incidence of 30%. Sahni et al^[5] reported that fissures of variable length and positions were present on various borders of the caudate lobe in 104 specimens.

Joshi et al^[3] reported the presence of caudate isthmus. The caudate lobe was noticed to be made up of two portions, connected by a narrow parenchymal bridge, which is known as the caudate isthmus. One part was situated to the left of the inferior vena cava, corresponding to the Spiegel's lobe or Couinaud's segment I. The other part extended in front of and to the right of the inferior vena cava. This part also extended caudally as a caudate process. This is termed as the paracaval portion.^[10] Singh^[9] and Chhabra et al^[11] reported an accessory caudate lobe of liver. Singh et al¹² reported duplication of caudate lobe. Caudate isthmus and accessory caudate lobe was absent in all specimens in the present study.

Chavan and Wabale^[7] and Sahni et al^[5] reported that the length ranged from 4.0 to 9.3 cm and 4.0 to 7.2 cm and width from 2.5 to 4.2 cm and 1.8 to 4.1 cm respectively. These findings were comparable with results of the present study (length: 3.38 – 7.03 cm and width: 1.20 – 4.24 cm).

Chavan and Wabale^[7] reported that the ratio of transverse dimension of caudate lobe to right lobe ranged between 0.28-0.46 which was slightly higher than Sahni et al^[5] i.e. 0.23-0.40. In the present study, the range of this ratio was found to be 0.15-0.58 (Average 0.36).

Chavan and Wabale^[7] reported that the caudate lobe undergoes compensatory hypertrophy when rest of the liver shrinks, as reported by many studies.^[13-15] This fact has been used to diagnose conditions such as cirrhosis of liver (CL/RL \geq 0.65).^[13] Moreover while assessing the size of caudate lobe to determine liver cirrhosis, portal vein or its branches might give false reading because of dilatation due to portal hypertension affecting them. In the present study, the ratio of caudate lobe to the right lobe ranged from 0.07 to 0.29.

CONCLUSION

The shapes of caudate lobes show different patterns of variability in different populations. Caudate lobe/Right lobe ratio is important for diagnosing conditions of the liver such as cirrhosis on Ultrasound/ Computed topography /Magnetic resonance imaging.

Knowledge and awareness of these variations are useful for Clinicians for the diagnosis and management of hepatic disorders, Surgeons during segmental resection of liver and Radiologist for avoiding misinterpretation of CT and MRI.

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