

## A Morphometric Study of the Adult Human Gall Bladder in a Cadaver and its Clinical Significance in the Eastern Indian Population

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Conflict of interest: Nil

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### Abstract

**Background:** Large gallbladder volumes observed in older individuals are predictors of impaired gallbladder motility and bile stasis which predispose one to gall stone as well as biliary sludge formation. The purpose of this research is to determine the morphology and variations of the adult human gall bladder in a cadaver, as well as its clinical significance in the Eastern Indian population and compare it with the incidence among various races in the world.

**Materials & Methods:** The present study comprised of 48 liver with gallbladder specimens obtained from 10% formalin fixed cadavers of both genders which were available in the Departments of Anatomy, and Forensic Medicine & Toxicology of Nalanda Medical College (Patna, Bihar, India) after getting approval from the institutional ethics committee and obtaining permission for the study from the heads of the department. The study was carried out over a two-years period, from July 2019 to June 2021. The gall bladder was examined, cleansed thoroughly, dissected, and studied. The following parameters such as length, transverse diameter, shape, external variants and length of part of gall bladder below the lower border of the liver was recorded.

**Results:** Gall bladder with length 3-7 cm was seen in 12, 7-10 cm in 28 and >10 cm in 8 cases. The mean breadth (cm) <3 was seen in 10, 3-5 cm in 30 and >5 cm in 8 cases. Shape was cylindrical in 14, pear in 22, hourglass in 10 and irregular in 2. External variants were phrygian cap in 4 and Hartmann's pouch in 7 cases. The difference was significant (P< 0.05).

**Conclusion:** A thorough knowledge of the various morphological and morphometric variants of the gall bladder is important for the operating surgeons neurosurgeons, radiologists. This study is also important for the teaching and acknowledgement of undergraduate and postgraduate students in anatomy as well as in surgery departments.

**Keywords:** Gall bladder, morphometric, liver

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## Introduction

Extrahepatic biliary apparatus comprises of gall bladder, cystic duct, hepatic ducts and common bile duct[1]. The gallbladder is a slate-blue, pear-shaped sac, partly sunk in a fossa or depressed area in the right hepatic lobe's inferior surface. It extends forward from a point near the right end of porta hepatis to the inferior hepatic border[2]. Its superior, or upper, surface is attached to the liver by connective tissue, and it is entirely covered by peritoneum elsewhere. It's a pouch-shaped or blind-ended diverticulum that leads to the cystic duct and finally attaches itself to the common bile duct. The gall bladder is 7–10 cm long and 3 cm wide at its widest point, with a 30–50 ml capacity. It is described as having a neck, body, and fundus [3]. It is also established that large gallbladder volumes observed in older individuals are predictors of impaired gallbladder motility and bile stasis which predispose one to gall stone as well as biliary sludge formation. Other than in advanced age, the GBV also increases in physiological processes such as pregnancy[4]. As observed with increased age, the preponderance of gallstone formation is also increased in pregnancy. Reduction in gallbladder contractility leads to biliary stasis and sludge formation hence the increased tendency of older individuals to form gallstones which result to cholecystitis[5]. The present study was conducted to assess morphometric study of adult human gall bladder in a cadaver.

**Aim and objectives:** The purpose of this research is to determine the morphology

### Result:

**Table 1: Length of gall bladder below the inferior or lower border of the liver**

Length	Mean	P value
3-7 cm	12	0.01
7-10 cm	28	
>10 cm	8	

Table 1 shows that gall bladder with length 3-7 cm was seen in 12, 7-10 cm in 28 and >10 cm in 8 cases. The difference was significant ( $P < 0.05$ )

and variations of the adult human gall bladder in a cadaver, as well as its clinical significance in the Eastern Indian population and compare it with the incidence among various races in the world.

### Materials & Methods

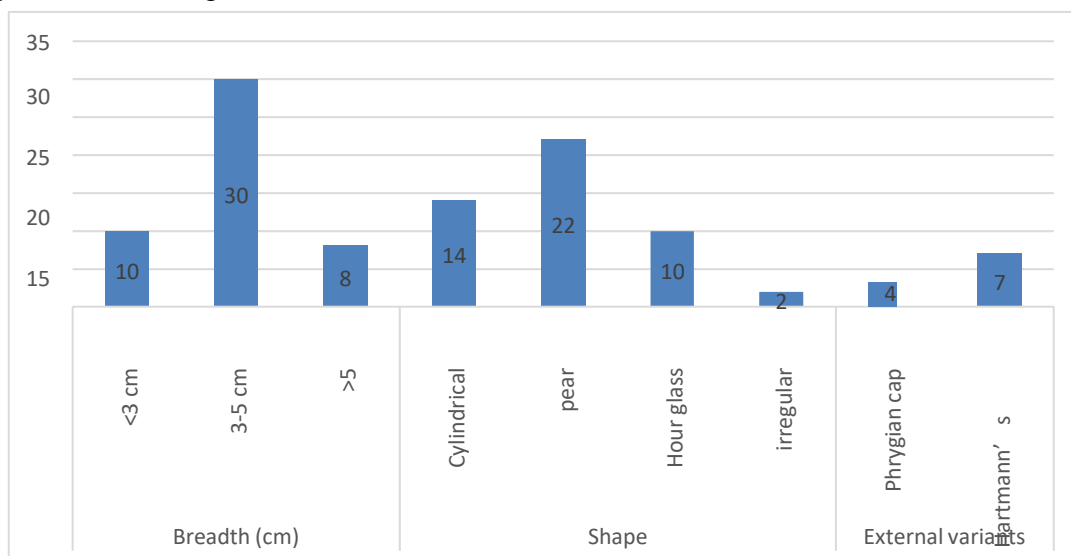
The present study is comprised of 48 liver with gallbladder specimens obtained from 10% formalin-fixed cadavers of both genders, which were available in the Departments of Anatomy and Forensic Medicine & Toxicology of Nalanda Medical College (Patna, Bihar, India)) after getting approval from the institutional ethics committee and obtaining permission for the study from the heads of the department. The study was carried out over a two-year period, from July 2019 to June 2021. The gall bladder was examined, cleansed with care, dissected, and studied. The following parameters, such as length, transverse diameter, shape, external variants, and length of the part of the gall bladder below the lower border of the liver, were recorded. Its maximum length and maximum transverse diameter were measured using a Vernier calliper and graduated in centimetres. The maximum length of the gall bladder was measured from the porta hepatis to the mid-point of the fundus. Maximum breadth measurements were taken perpendicular to the long axis of the gall bladder at the region of maximum gallbladder width and were noted. The data thus obtained was subjected to statistical analysis. P value  $< 0.05$  was considered significant.

**Table 2: Assessment of other parameters**

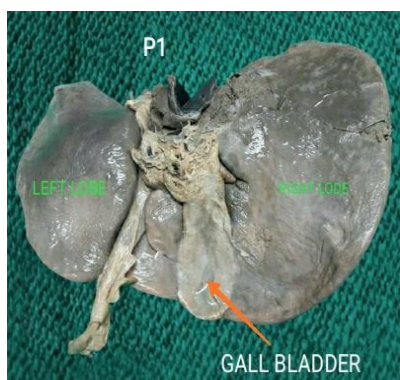
Parameters	Variables	Number	P value
Breadth (cm)	<3	10	0.05
	3-5	30	
	>5	8	
Shape	Cylindrical	14	0.03
	pear	22	
	Hour glass	10	
	irregular	2	
External variants	Phrygian cap	4	0.05
	Hartmann's pouch	7	

Table 2, graph 1 shows that mean breadth (cm) <3 was seen in 10, 3-5 cm in 30 and >5 cm in 8 cases. Shape was cylindrical in 14, pear in 22, hour glass in 10 and

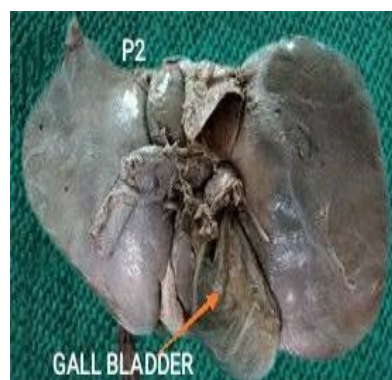
irregular in 2. External variants were phrygian cap in 4 and Hartmann's pouch in 7 cases. The difference was significant (P< 0.05).



**Figure 1: Assessment of other parameters**



**Figure P1: Cylindrical shaped gall bladder**



**Figure P2: Pear shaped gall bladder**



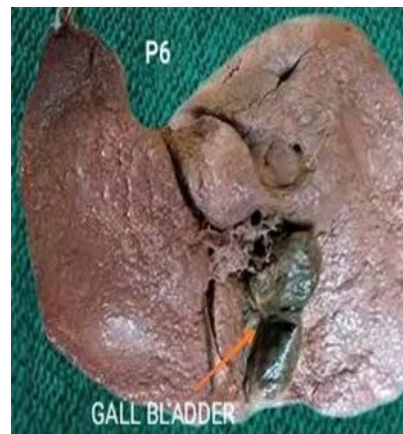
**Figure P3: Irregular shaped gall bladder**



**Figure P4: Retort shaped gall bladder**



**Figure P5: Hartmann's shaped gall bladder**



**Figure P6: Hourglass shaped gall bladder**



**Figure P7: Phrygian cap (Folded fundus) shaped gall bladder**



**Normal sonogram: Normal Ultrasound image of abdominal organ - Gall Bladder**

**Discussion:**

The liver, gall bladder, and biliary ductal system begin to grow from the hepatic

endodermal diverticulum of the foregut at the beginning of the fourth week of normal human foetal development [6]. The diverticulum proliferates and projects into

the septum transversum, which is a mesodermal plate present between the stalk of the yolk sac and the pericardial cavity [7]. It is then split into two parts: the cranial bud, which gives rise to the liver and bile ducts, and the caudal bud, which gives rise to the gall bladder and cystic duct [8]. Any malformation in the extrahepatic biliary system or apparatus may be caused due to some alterations in the normal embryonic development [9]. The present study was conducted to assess morphometric study of adult human gall bladder in a cadaver. We found that gall bladder with length 3-7 cm was seen in 12, 7-10 cm in 28 and >10 cm in 8 cases. Shivnal et al [10] in their study 50 liver with Gallbladder specimens obtained from 10% formalin fixed cadavers of age group 50-60 years in the department of Anatomy. The gall bladder was observed, dissected carefully and studied for its parameters i.e. length and breadth using Vernier calipers. The variations shape, external morphological features, and location were all noted. In 52% of the specimens, the length of the gall bladder specimens ranged from 7 to 10 cm. 68 % of the specimens had transverse diameters ranging from 3 to 5 cm. Pear, Hourglass, Retort, Cylindrical, and Flask or irregular shaped flasks were among the shapes observed. In this study, the most common form observed and documented was pear-shaped in 26 specimens (52 %). Folded fundus (Phrygian cap) of gall bladder was found in 2 out of 50 specimens (4%) and Hartmann's pouch was found in 7 out of 50 specimens (14%). We observed that mean breadth (cm) <3 was seen in 10, 3-5 cm in 30 and >5 cm in 8 cases. Shape was cylindrical in 14, pear in 22, hour glass in 10 and irregular in 2. External variants were phrygian cap in 4 and Hartmann's pouch in 7 cases. Kariuki et al [11] in their study found that the mean gallbladder volume was 47.948 ( $\pm$ 19.080) cm<sup>3</sup> and showed a statistically significant increase with age. There was also a significant increase of gallbladder length and

diameter ( $p < 0.001$ ). A positive correlation was observed between gallbladder length, diameter and volume; 0.282, 0.485 and 0.480 respectively ( $P=0.01$ ). Gallbladder volume, which is a function of length and diameter, increases with age in a statistically significant way. These parameters show a significant increase after the fifth decade. This could explain the 4-to-10-fold increase in cholelithiasis prevalence after the fifth decade of life. Futara et al [12] observed and recorded that there was a higher prevalence of kinking of the gallbladder and Hartmann's pouch in the females than in male subjects which may be related to the higher cases of gall bladder stone formation and biliary tract diseases in females. Pirraci et al [13] studied 9481 subjects taking measurements of gall bladders by ultrasonography [14]. These findings further suggest that measurements obtained from cadaveric specimen and those from ultrasonography done in vivo are comparable.

### Conclusion:

Understanding the knowledge of the various morphological and morphometric variants of the gall bladder is important for the operating surgeons, neurosurgeons, radiologists. This study is also important for the teaching and acknowledgement of undergraduate and postgraduate students in anatomy as well as in surgery departments.

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