



UNVEILING GALLBLADDER DIVERSITY: A CADAVERIC EXPLORATION OF EXTERNAL MORPHOLOGY

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ABSTRACT Variations in the extrahepatic biliary tract are commonly encountered during surgical procedures. To investigate these anomalies, a study was conducted on the external morphology of forty embalmed gallbladders. Divergences in gallbladder dimensions and shape, as well as atypical features like a folded neck or fundus (Phrygian cap), were observed. These variations are primarily attributed to irregularities or interruptions in normal embryonic development. The significance of understanding such anomalies extends beyond biliary diseases, as they also impact the planning and execution of various invasive treatments for gallbladder and extrahepatic bile duct conditions.

KEYWORDS : Gall Bladder, External Variations, Hourglass Gallbladder, Folded Neck, Folded Fundus

INTRODUCTION:

While humans share a general anatomical blueprint, detailed examination of specific regions reveals surprising variability. The extrahepatic biliary apparatus is a prime example of this, with such frequent anomalies that some experts argue against a "normal" anatomy. Instead, they propose a common pattern of variations that surgeons must recognize to avoid complications. Anomalies can originate in the gallbladder, cystic duct, hepatic ducts, or common bile duct, emphasizing the importance of understanding these variations for successful surgical outcomes.

This study focused on the external morphology of the gallbladder as part of a larger investigation into the extrahepatic biliary apparatus.

MATERIAL AND METHODS:

Forty gallbladders were procured from 10% formalin-fixed cadavers at the Department of Anatomy, Baroda Medical College, Vadodara, Gujarat. Cadavers with prior abdominal surgery or crush injuries were excluded. Data analysis was performed using Microsoft excel, with statistical significance set at the 5% level.

RESULTS:



Figure 1- Smallest gallbladder



Figure 2- Largest gallbladder



Figure 3 Pear shape gallbladder

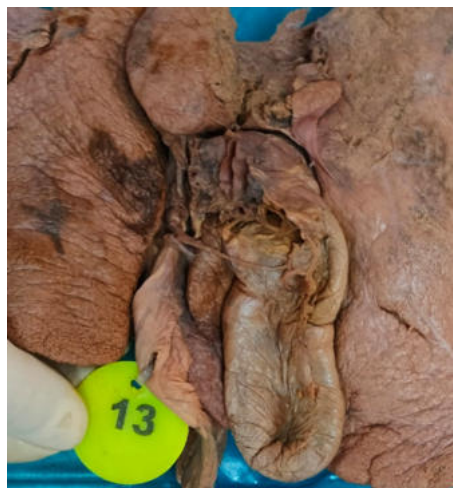


Figure 4- Cylindrical gallbladder



Figure 5- Hourglass gallbladder



Figure 6- Irregular gallbladder



Figure 7- Flask shape gallbladder



Figure 8- Folded fundus



Figure 9- Folded neck

1. Dimensions of the gall bladder

a. Gallbladder lengths ranged from 4.49 cm to 10.03cm, with 70% (n=28) measuring between 5 and 8 cm. The smallest gallbladder (4.49 cm) is illustrated in Figure 1, and the largest (10.03 cm) in Figure 2. These findings are summarized in Table 1.

b. Gallbladder breadth ranged from 1.83 cm to 4.55 cm, with 55% (n=22) measuring between 3 and 4 cm. The mean breadth was 3.19 ± 0.5 cm. A positive correlation between gallbladder length and breadth was observed ($r=0.381$,

$p=0.04$). These data are presented in Table 1.

2. Shapes of the gall bladder.

Gallbladder shapes included pear, cylindrical, hourglass, irregular, and flask shapes. Their frequencies are summarized in Table 1 and illustrated in Figures 3-7.

3. External Variations of gall bladder.

Folded fundus and folded neck were identified as external variations in 17.5% (n=7) of the gallbladders. These findings, along with their frequencies, are presented in Table II and illustrated in Figures 8-9.

Table 1: Measurements And Shapes Of Gall Bladder

Length in cms.	No. Of Specimen	Percentage
<5	3	6.81%
5-8	28	63.63%
8-10.03	9	20.45%
BREADTHS in cms		
<3	6	13.63%
3-4	22	50%
>4	12	27.27%
SHAPES OF GALL BLADDER		
Pear shape	21	47.72%
Flask	1	2.27%
Cylindrical	6	13.63%
Hourglass	2	4.54%
Retort	0	0%
Irregular	6	13.63%

Table II: External Variations Of The Gall Bladder

External variation	Position of folding	No. of specimens	Percentage
Folded fundus (Phrygian cap)	Anteriorly	0	0%
	Posteriorly	6	13.63%
Folded neck	Anteriorly	0	0%
	Posteriorly	1	2.27%
Folded Fundus & neck	Posteriorly	0	0%

Table III: Length Breadth And Shape Of Gall Bladder As Per Observations Of Various Workers

No.	Researcher / Year	Length (cm)	Breadth (cm)	Shape
1	Turner & fulcher(2000)	10	3-5	Elliptical
2	Moore & dalley (2006)	7-10	-	Pear
3	Chari & shah (2008)	7-10	2-5	Pear
4	Vakili & pomfret(2008)	7-10	4	Piriform
5	Standring(2008)	7-10	-	Flask
6	Jaba & satyam (2012)	5-12	2.5-5	Pear(85%), flask(5%), Cylindrical (3.33%), or Hourglass & Retort or irregular (1.67%)
7	Nadeem g (2016)	4.5-11.6	2.5 -5	Pear
8	Bharathi d(2020)	6-10	At the level of Neck: 1 to 2 Body: 2 to 3.5 Fundus: 2.5 to 3.5	Pear (76.67%)

9	Shiva)	7 nal (2021-10	3-5	Pear(52%), cylindrical(22%), Hourglass(14%), Retort(10%), irregular(2%)
10	Priya p roy (2022)	6.89	3.55	Pear (43.33%), flask (25%), cylindrical(20%), irregular(6.67%), and hourglass (5%).
11	Present study	4.49-10.03	1.83-4.55	Pear(47.72%), hourglass(4.54%), irregular(13.63%), flask shape(2.27%), small(2.27%), large(6.81%), cylindrical(13.63%)

DISCUSSION

The liver, gallbladder, and biliary ductal system originate from the hepatic diverticulum of the foregut during the fourth week of development. This diverticulum rapidly expands into the septum transversum and bifurcates into two sections. The cranial portion develops into the liver and bile ducts, while the caudal part forms the gallbladder and cystic duct. Initially, the extrahepatic biliary apparatus is blocked by epithelial cells, which subsequently degenerate, allowing for canalization. Any disruption or deviation from this normal developmental process can lead to malformations of the gallbladder and biliary system.

Gallbladder size and shape exhibit significant variability, often making anatomical distinctions challenging. While a relaxed gallbladder typically measures approximately 10 cm in length and 3-5 cm in diameter, our findings align with those of Chiari and Shah (2008) for most specimens.

Gallbladder breadths in this study ranged from 1.83 to 4.55 cm, consistent with findings by Chiari and Shah (2008) & Jaba Raj guru(2010). Table III provides a comparison of gallbladder length, breadth, and shape as reported by various researchers.

Gore et al. (2000) reported that gallbladder size can increase following vagotomy, in diabetes (due to autoimmune neuropathy), pregnancy, sickle cell disease, cystic duct or common bile duct obstruction, and extreme obesity. Conversely, a micro gallbladder is often associated with cystic fibrosis.

The most common gallbladder shape in our study was pear-shaped (47.72%), aligning with findings from Moore and Dalley (2006) , Chari and Shah (2008) and Jaba Raj guru(2010).Cylindrical, hourglass, and retort (boomerang) shapes, described by Hollingshead (1983), Shaher (2005), and Meilstrup et al. (1991), respectively, were also observed, albeit less frequently.

Gallbladder development is relatively consistent, with the most notable variations occurring in the fundus and neck. Our study identified neck folding over the gallbladder body in 2.27% of specimens, with posterior folding in 2.27%. Meistrup et al. (1991) described gross gallbladder bending, either posteriorly or anteriorly, which can appear unusual on imaging studies. Futura et al. (2001) reported a higher prevalence of gallbladder kinking and Hartmann's pouch in women, potentially linked to increased gallstone formation and biliary tract diseases in this population.

The folded fundus of the gallbladder, commonly known as the Phrygian cap, has a reported prevalence of 3-7.5% (Lichtenstein & Nicosia, 1955), attributed to a size mismatch between the gallbladder and its bed, without pathological implications. Deutsch (1986) considered it a form of underdeveloped congenital septum, while Gore et al. (2000) observed a fold or septum within the gallbladder. Our study found a Phrygian cap incidence of 13.63% which was not consistent with Lichtenstein & Nicosia and Gore et al. Recent studies by de Csepel et al. (2003), Chalkoo (2009), and Talpur et al. (2010) also reported the presence of a gallbladder septum, with Talpur et al finding a prevalence of 0.33%.

CONCLUSION

While bizarre gallbladder variations have been documented extensively through case reports, comprehensive studies on their morphology and incidence remain scarce. Although these anomalies often remain asymptomatic, they can lead to complications and thus have significant clinical implications. Given the surge in laparoscopic cholecystectomies, a thorough understanding of gallbladder anatomical variations is essential. Accurate knowledge of this region's anatomy is pivotal for the successful execution of both diagnostic and therapeutic invasive procedure.

Acknowledgement

I express sincere gratitude to Dr. Kintukumar Vyas , Associate Professor at Baroda medical College, Vadodara .for his guidance throughout this study.

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