

CMRO 02 (10), 293-298 (2019)

ISSN (O) 2589-8779 | (P) 2589-8760

Morphology of Gall Bladder- A Cadaveric Study

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(DOI: https://doi.org/10.15520/jcmro.v2i10.217

Accepted 15-10-2019; Received 20-09-2019; Publish Online 16-09-2019

Reviewed By: Dr. Marwa Muhammad	ABSTRACT Aim: To study variations in external morphology of cadaveric gall bladder. Materials and
Department: Reviewer/CMRO	 Methods: This study was undertaken on 30 cadaveric liver and gall bladder specimens in the Department of Anatomy at Tertiary Medical College of West Uttar Pradesh in terms of maximum length, maximum transverse diameter, thickness, shape, external variations and length of gall bladder below the inferior border of the liver using vernier caliper. Results: Gall bladder had length ranging between 5.52 and 11.32 cm, transverse diameter between 2.78 and 5.57 cm, thickness at neck, body and fundus was not found uniform. The commonest shape observed in this study was pear shaped. The length of gall bladder below the inferior border of liver varied between 0.46 and 3.93 cm. Conclusion: Since the incidence of gall bladder illness in our country is increasing day by day hence morphological knowledge is essential, not only from the point of biliary disease but also with respect to the various laprascopic, surgical and invasive techniques for example T-tube cholangiogram in the proper diagnosis and management of gall bladder and extrahepatic bile duct diseases. The morphological data may be useful to the surgeon's radiologists and anatomists. Key words: Gall bladder, Morphometry
1 INTRODUCTION:	tigate one particular region with more detail, it is surprising

The gallbladder is a slate-blue, piriform sac, partly sunk in a fossa in the right hepatic lobe's inferior surface. It extends forward from a point near the right end of the porta hepatis to the inferior hepatic border. Its upper surface is attached to the liver by connective tissue; elsewhere it is completely covered by peritoneum continued from the hepatic surface. It is a blind ending diverticulum attached to the common bile duct by the cystic duct [1].

Gall bladder is 7–10 cm long, 3 cm broad at its widest and 30–50 ml in capacity[[1]. It is described as fundus, body and neck. The fundus is the expanded end which projects down, forward and to the right, extending beyond the inferior border of the liver to come in contact with the anterior abdominal wall behind the ninth right costal cartilage. The body is directed up, back and to the left; near the right end of the porta it is continuous with the gallbladder neck. The neck is narrow projecting forwards and then abruptly back and downwards, to become the cystic duct.

Though human beings are thought to be similar in their general anatomical phenotype, but when we come to inves-

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tigate one particular region with more detail, it is surprising how frequently we meet one sort or another type of variations [2]. Understanding of these variants is important before laparoscopic procedures.

The present study will be of great help to surgeons and radiologists to understand the external morphology of the gall bladder.

2 MATERIALS AND METHODS:

This study was carried on 30 liver and gallbladder specimens obtained from 10% formalin fixed cadavers in the Department of Anatomy of Shri Ram Murti Smarak – Institute of Medical Sciences, Bareilly, Uttar Pradesh.

Cadavers with obvious abdominal surgery and crush injury to the abdominal organs were excluded from the study.

The parameters studied were the maximum length, maximum transverse diameter, thickness, shape, external variations of gall bladder, Level i.e. length of gall bladder below the inferior border of the liver.

The maximum length was measured from the porta hepatis to the mid-point of the fundusFigures 1 and 2 and the maximum transverse diameter Figures 3 and 4 was measured from the porta hepatisFigure 5 as well as from the

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inferior border of the liver Figure 6 by using vernier caliper in centimeters.

The shape and any variation in external appearance of gall bladder were noted. Part of the gall bladder i.e. fundus that lie below the inferior border of liver was noted.

The thickness of the gallbladder wall was measured by fine dissecting method. A longitudinal incision was made by sharp B-P blade through the peritoneal smooth surface of the gallbladder from fundus to neck and interior of the gallbladder was cleaned with jets of tap water. Then the thickness of wall of the gallbladder was measured in centimeters at the maximum transverse diameter of the fundus, body & neck region of the gallbladder with the help of vernier caliperFigures 7, 8 and 9. For taking measurements the non peritoneal surface was not chosen due to rough and irregular surface.

Maximum length:



Figure 1.

Maximum transverse diameter: Thickness:



Figure 3.



Figure 4.



Figure 2.



Figure 5.



Figure 6.



Figure 9. Neck

3 **RESULTS:**

Maximum length of gall bladders Table 1:



Figure 7. Fundus



Figure 8. Body

Average length of gall bladder was found to be 8.25 cm. The smallest gall bladder was 5.52 cm in length and the largest had length 11.32 cm. 70 % (21/30) had length ranging between 7 and 10 cm.

Table 1. Length of gall bladders

Length in centimeters	No of specimens	Percentage (%)
< 7	6	20
7 - 10	21	70
> 10	3	10

Maximum transverse diameter of gall bladders Table 2:

Mean breadth of gall bladder was 4.30 cm. The shortest transverse diameter was 3.06 cm and largest 5.57 cm. 53.33% (16/30) had a maximum transverse diameter between 3 and 4 cm.

The distance of the maximum transverse diameter of gall bladder from the porta hepatis was found to be ranging between 2.46 and 7.06 cmFigure 5 and from the inferior border of the liver between 1.43 and 5.37 cm Figure 6.

Table 2. Transverse diameter of gall bladders

Transverse diameter in	No of	Percentage
centimeters	specimens	(%)
< 3	1	3.33
3 - 4	16	53.33
> 4	13	43.33

Shape of gall bladder:

The gall bladders were classified according to their shapes. Various shapes were observed. The commonest shape found was pear shaped (21/30, 70%). Their incidences are shown in the Table 3.

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Table 3. Different shapes of gall bladders

Shape	No of specimens	Percentage (%)
Pear shaped	21	70
Cylindrical	3	10
Tubular	2	6.66
Boot	1	3.33
Irregular	1	3.33
Retort	1	3.33
S-shaped	1	3.33



Pear

Cylindrical

Tubular



Boot

Irregular

S-shaped



Retort

External appearance of gall bladder:

Foldings of neck and fundus (whether anteriorly or posteriorly) were observed. Folding of fundus was noted in 2 out of 30 specimens of GB. Hartmann's pouch was also observed in 1 specimen.



Folded fundus (Phyrgian cap)

Hartmann's pouch

Length of gall bladder below inferior border of the liver: 21 gall bladders were crossing the inferior border of the liver and the length varied between 0.46 - 3.93 cm Figure 10.

Thickness of gall bladder:

The thickness of gall bladder was found different at neck, body and fundus.



Figure 10.

Table 4. Thickness of gall bladders

Thickness	(mm)
Fundus	1.35 - 1.69
Body	1.30 - 1.75
Neck	0.46 - 0.95

4 DISCUSSION:

The gall bladder, liver and the biliary ductal system develop from the hepatic endodermal diverticulum of the foregut, at the beginning of the fourth week of development .This diverticulum rapidly proliferates into the septum transversum and divides into two parts – the cranial part develops the liver and the bile ducts while the caudal part gives rise to the gall bladder and the cystic duct. Any arrest or deviation from the normal embryological developmental process may result in some sort of malformation of the gallbladder and of the biliary system [3].

Comparison of length and breadth with other studies has been shown in Table 5.

Table	5.	Length	\mathbf{and}	Transverse	diameters	of	gall	bladder	as
re-ported by other authors									

S No.	Authors	Length	Transverse
		of gall	diameter of
		blad-	gall
		der	Bladder
1.	Chari RS & Shah	7 –	2-5cm
	SA [2]	$10 \mathrm{cm}$	
2.	Turner MA et al [4]	$10 \mathrm{cm}$	$3 - 5 \mathrm{cm}$
3.	Vakili K & Pomfret	7 –	4cm
	EA [5]	$10 \mathrm{cm}$	
4.	Rajguru J et al [6]	5 –	2.5-5cm
		$12 \mathrm{cm}$	
5.	Prakash AV et	7 –	2-5cm
	al [7]	$10 \mathrm{cm}$	
6.	Present study	5.52 -	3.06 –
		$11.32 \mathrm{cm}$	$5.57 \mathrm{cm}$

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Size of gall bladder varies in different diseased conditions as well as in some physiological conditions too. It may be impossible sometimes to distinguish between various parts described. The size of gall bladder may increase after vagotomy, diabetes, pregnancy, sickle cell disease, after cystic duct or common bile duct obstruction [6].

Shapes of gall bladder vary and various authors have described various shapes as seen in Table 6. We found pear shaped gall bladder as most common (70%).

Table 6. Shapes of gall bladders

S.No	Authors	Shape
1.	Standring S [1]	Piriform
2.	Chari RS & Shah	Pear
	SA [2]	
3.	Turner et al $[4]$	Elliptical
4.	Vakili K & Pom-	Piriform
	fret EA [5]	
5.	Rajguru J et al [6]	Pear (85%), Flask (5%), Cylindrical (3.33%), Hour- glass, retort and irregular (1.67%)
6.	Prakash AV et al [7]	Pear (82.22%)
7.	Moore KL & Dal-	Pear
	ley AF [8]	
8.	Present study	Pear (70%), Cylin- drical (10%), Tubular (6.66%), Boot, Irregular, Retort and S – shaped (3.33%)

The gall bladder is relatively constant in its development and the two most significant variations are the folded fundus and variation at the neck of the gall bladder [6]. The folded fundus of the gall bladder, also called as the Phrygian cap, was reported in 3 - 7.5% of gall bladder by Lichtenstein M & Nicosia AJ [9]. They proposed that it could due to a disproportion between the size of the gall bladder and that of the gallbladder bed, but without any pathological significance. Deutsch AA et al [10] and Gore RM et al [11] recorded folded fundus in very few percentage of gall bladder. Meilstrup JW et al [12] observed that gross bending of the gallbladder could occur posteriorly or anteriorly and lead to bizarre or unusual shapes when visualized by sonography and other imaging techniques. Futara G et al [13] observed that there was a significantly higher prevalence of kinking of the gallbladder and Hartmann's pouch in the females than in male subjects which could be related to the higher rate of gallstone formation and biliary tract diseases in females. In our study, we found folded fundus in 2 specimens (6.66%).

The length of gall bladder below the inferior border of the liver in our study was between 0. 46 - 3.93 cm. Prakash AV et al [7] reported between 0.4 - 2.5cm. This is the most susceptible part of gall bladder that can be damaged in laparoscopic procedures [1].

The thickness of the gall bladder at fundus, body and neck were $1.35\text{-}1.69\mathrm{mm},\,1.30-1.75\mathrm{mm}$ and $0.46-0.95\mathrm{mm}$

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respectively. We couldn't find any literature regarding this parameter. Gallbladder diseases are diagnosed clinically and confirmed by various non invasive as well as invasive procedures and wall thickness is the most important indicator to diagnose such diseases [14]. In diseases such as cholecystitis, carcinoma and metastasis of gall bladder.

However congenital anomalies of gallbladder are rare and can be accompanied with other biliary and vascular malformations [15]. Due to these anatomical variations, complications seen were bleeding and biliary leaks leading morbidity [16]. The comparative study involving GB morphometry in cadavers and sonographic/ radiological findings should be undertaken.

5 CONCLUSION:

The occurrence of bizarre forms of anatomical variations of gall bladder and extra-hepatic biliary tree though are not common but can be of clinical importance, however comprehensive study of the morphological variations of the gall bladder and their incidence is relatively scarce. Most of the interventional procedures in this modern era are done laparoscopically and there is tremendous increase in number of laparoscopic cholecystectomies. So, thorough knowledge of possible variations in morphology of gall bladder is important. Awareness of these anomalies will decrease morbidity, and re-exploration in these patients. This article will be of utmost useful to the surgeons and radiologists to understand and identify possible variations of GB morphology.

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