ORIGINAL ARTICLE

Study of Morphological Variations of Gall Bladder in Eastern Indian Cadavers

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Abstract:

Background: Gall bladder presents variable morphology, the knowledge of which is essential for various diagnostic and surgical procedures involving gall bladder. *Aim and Objectives:* To study the morphological variations of gall bladder in embalmed human cadavers. *Material and Methods:* The study included livers extracted from forty (40) embalmed human cadavers dissected for undergraduate MBBS classes in a medical college in Eastern India during the period August 2013 to May 2019. The dimensions of gall bladder was measured with a metal scale and variations in their shape and external features were noted. *Results*: The mean length and breadth of gall bladder was found to be 7.54 ± 1.62 cm (3.6-12.2 cm) and 3.44 ± 0.76 cm (1.8-6 cm) respectively. The various shapes of gall bladder were pear shaped (80 %), flask shaped (5%), cylindrical (5%), irregular (5%) and quadrate (2.5%). The external variations of gall bladder were as follows- atrophic gall bladder (2.5%), deeply placed gall bladder (2.5%), absent gall bladder (2.5%), folding of neck of gall bladder (5%), phrygian cap (5%) and Hartmann's pouch (2.5%). *Conclusion*: The study will be of use for surgeons performing laparoscopic cholecystectomy in minimising hepato-biliary injuries.

Keywords: Gall Bladder, Morphology, Laparoscopic Cholecystectomy.

Introduction:

The gall bladder is a pear-shaped hollow viscus situated on the under surface of right lobe of liver extending from the right end of porta hepatis to the inferior border of liver. It measures 7 cm to 10 cm in length, 3 cm in maximum width and has a capacity of 30-50 ml. The gall bladder presents three parts- fundus, body and neck. The neck leads to cystic duct which opens into right side of common hepatic duct. Gall bladder varies highly in dimensions, shape and morphology. It may be double, bifid or altogether absent [1]. It may bear a phrygian cap which is usually demarcated on the fundus of gall bladder. The phrygian cap is reported as a septum within an otherwise normal gall bladder on ultrasound examination of abdomen [1]. Sometimes a rudimentary gall bladder may coexist with other anomalies like tracheo-oesophageal fistula or imperforate anus [2]. The surgeries and radiological interventions involving gall bladder are very common these days [3]. The most common surgical procedures performed on biliary tract is cholecystectomy. Failure to recognize the variations in dimensions and morphology of the gall bladder may give rise to inadvertent ductal ligation, biliary leaks and strictures (incidence 0.5-6%) following laparoscopic cholecystectomy [4]. So, we have attempted to enlist and elucidate the variations in size and morphology of gall bladder with associated clinical importance in the current study.

Material and Methods:

The study comprised of forty (40) human livers extracted from embalmed cadavers in the Department of Anatomy of a medical college of Eastern India. The study period spanned from August 2013 to May 2019. The gall bladders in all the liver specimens were measured for their dimensions with their morphology being noted. A metal scale was used to measure the length and width of each gall bladder. The length was measured as the distance from fundus to neck. The width (maximum transverse measurement) was also measured. The position, shape, and any external variation (pear shaped, flask shaped, cylindrical, hourglass shaped, retort shaped, bilobed, irregular) [2-5] of the gall bladders were noted as well. The data was tabulated and analysed using Microsoft Office 2007 Excel software. Mean and standard deviation were obtained for length and width of the gall bladders studied.

Results:

The length of the gall bladder was recorded to be ranging between 3.6 cm and 12.2 cm. The mean length was derived to be 7.54 ± 1.62 cm. The maximum width of gall bladder ranged from 1.8 to 6 cm. The mean width was 3.44 ± 0.76 cm. The shape of the gall bladder displayed considerable variations. Most of the gall bladders (32 in number or 80%) were pear shaped (Fig. 1). Two gall bladders (5%) were flask shaped (Fig.2). Two gall bladders (5%) were cylindrical (Fig.3). One gall bladder (2.5%) was found to be quadrate in shape (Fig.4). However, two gall bladders (5%) did not present any remarkable shape and hence were classified as having irregular shape (Fig.5). The gall bladders in the current study exhibited significant external variations. One gall bladder (2.5%) was of considerable small size and hence classified as atrophic (Fig.6). The gall bladder was characteristically absent in one liver (Fig.7). A liver in the study (2.5%) showed a deeply placed gall bladder (Fig.8). The neck of the gall bladder was folded (Fig.9) in two specimens (5%). Folding of the fundus of gall bladder (Fig.10) or Phrygian cap was observed in two specimens (5%). One gall bladder (2.5%) was found to have Hartmann's pouch (Fig.11). On plotting a scatter diagram with length of gall bladder along X-axis and width of gall bladder along Y-axis a linear correlation was observed (Fig.12). A linear increase in width could be observed with increasing length of the gall bladders studied.

Fig. 1: Pear Shaped Gall Bladder

Fig. 2: Flask Shaped Gall Bladder

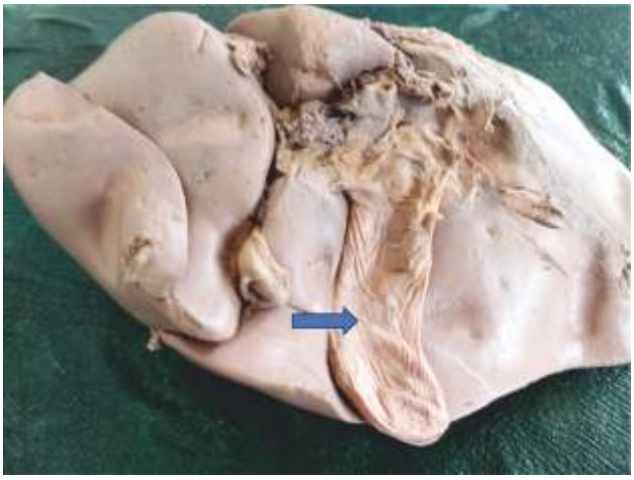

Fig. 3: Cylindrical Gall Bladder

Fig. 4: Quadrate Shaped Gall Bladder

Fig. 5: Irregular Gall Bladder

Fig. 6: Atrophic Gall Bladder

Fig. 7: Absent Gall Bladder

Fig. 8: Deeply Placed Gall Bladder

Fig. 9: Gall Bladder with Folding of Neck

Fig. 10: Gall Bladder with Phrygian Cap

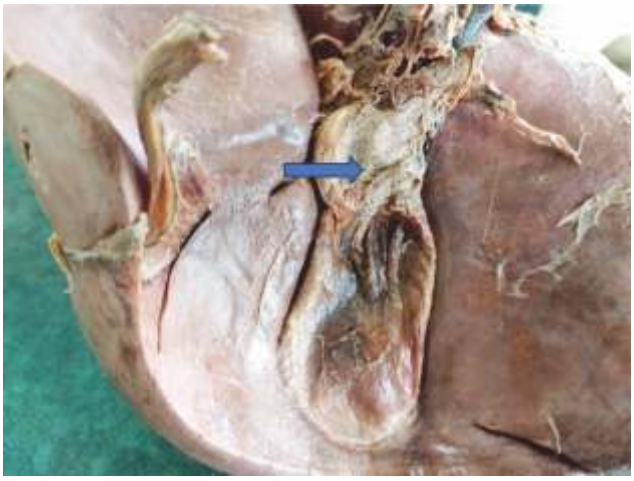

Fig. 11: Gall Bladder with Hartmann's Pouch

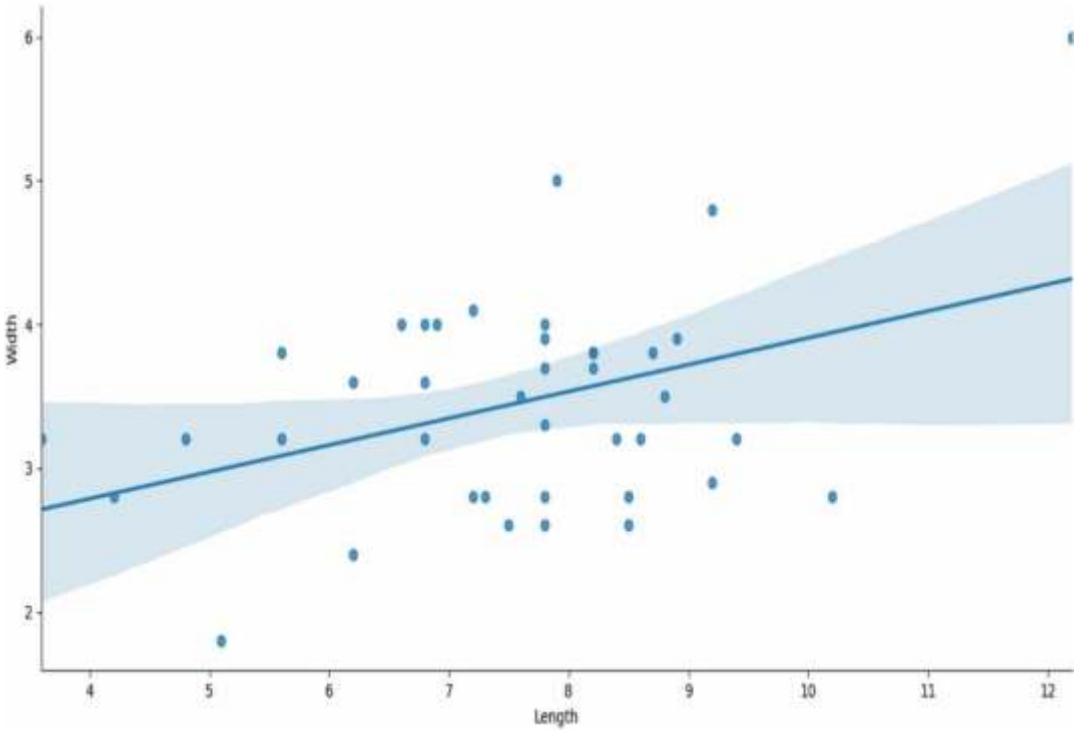

Fig. 12: Scatter Diagram Plotted by Taking Length of Gall Bladder along X-Axis and width of Gall Bladder along Y-Axis

Discussion:

The current study established the length and width of gall bladder as 7.54 ± 1.62 cm (3.6-12.2 cm) and 3.44 ± 0.76 cm (1.8-6 cm) respectively. The dimensions of gall bladder reported in the current study are similar to the findings of the various authors [2-7] as depicted in Table 1.

Enlarged gall bladder is a feature of obesity, pregnancy, diabetes mellitus, sickle cell anemia and in cases of truncal and selective vagotomy. Gall bladder size is diminished in cystic fibrosis [8].

Hepatic diverticulum arising from the junction of embryonic foregut and midgut gives rise to pars hepatica and pars cystica. Pars hepatica forms liver whereas pars cystica forms gall bladder [9]. Any aberration from normal embryological process results in variations of size and form of gall bladder, many of which are reported in the current study.

Our study has reported variations in shape of gall bladder on similar lines as other authors [2, 3, 5-7] as depicted in Table 2. The current study has observed pear shaped, flask shaped, cylindrical, quadrate and irregular shaped gall bladders. The most common shape of gall bladder was noted to be pear shaped like the earlier studies. Most notably, quadrate shaped gall bladder observed in the current study, has not been reported by other authors till date.

Table 1: Showing Length and Width of Gall Bladder as per Various Authors

Author	Length of gall bladder in cm	Width of gall bladder in cm
Tiwari [2]	Mean length - 6.79±1.45	Mean width- 2.81±0.79
Nadeem [3]	4.5- 11.6	2.7- 5.2
Prakash *et al.* [4]	7- 10	2- 5
Rajguru *et al.* [5]	5- 12	2.5- 5
Desai *et al.* [6]	4.5- 11	2.8- 5
Rajendra *et al.* [7]	4- 11	2.5- 5

Table 2: Showing Frequency of Different Shapes of Gall Bladder as per Various Authors

Author	Frequency of various shapes of gall bladder
Tiwari [2]	52% pear shaped, 28% flask shaped, 12% cylindrical, 4% hourglass shaped, 4% irregular
Nadeem [3]	82.85% pear shaped, 2.86% cylindrical, 1.43% bilobed, 7.14% irregular
Rajguru *et al.*[5]	85% pear shaped, 5% flask shaped, 3.33% cylindrical, 3.33% hourglass shaped, 1.67% retort shaped, 6.7% irregular
Desai *et al.* [6]	84% pear shaped, 10% cylindrical, 2% hourglass shaped, 4% retort shaped
Rajendra *et al.* [7]	53.2% pear shaped, 11.4% cylindrical, 6.3% hourglass shaped, 11.4% oval, 16.5% irregular

One of the external variations of gall bladder observed in the current study is Phrygian cap (5% cases). In this case, the fundus of gall bladder is folded on itself resulting in partial separation of body from fundus of gall bladder. However, Phrygian cap is said to bear no functional or clinical significance [10]. Phrygian cap of gall bladder has been reported earlier by Tiwari [2], Prakash *et al*. [4], Rajguru *et al*. [5] and Desai *et al.* [6].

Folded neck is another external variation of gall bladder reported in the current study similar to Tiwari *et al.* [2], Prakash *et al*. [4], Rajguru *et al.* [5] and Desai *et al.* [6].Our study has reported Hartmann's pouch in 2.5% cases. Hartmann's pouch is a widening seen at the lateral end of neck

of the gall bladder. It's often associated with gall stones and carcinoma of gall bladder [2]. A reasonably large Hartmann's pouch may obscure cystic duct and Calot's triangle, making cholecystectomy difficult [11]. An impacted gall stone in the Hartmann's pouch gives rise to mucocele of gall bladder. External compression of common hepatic duct or common bile duct by gall stones in the Hartmann's pouch results in Mirizzi's syndrome leading to jaundice. So, the surgeons operating in cases of cholelithiasis should keep in mind the consequences of gall stones impacted in the Hartmann's pouch. Frequency of Hartmann's pouch has been reported as 8% by Tiwari [2], 7.14% by Nadeem [3], 5.7% by Nahar *et al*. [12] and 4% by Dundareddy and Suman [13].

We have found a case of deeply placed gall bladder which can be classified as partial intrahepatic gall bladder [2]. In this case, the partially buried gall bladder is projecting from within the liver. It is an anomaly of development of gall bladder and caused due to arrest in movement of the gall bladder from its initial intrahepatic position to its usual superficial location [2]. Intrahepatic gall bladder leads to stasis of bile and results in cholelithiasis. Inflammation of intrahepatic gall bladder poses challenges for diagnosis of cholecystitis as there's little or no associated peritoneal inflammation [14]. The incidence of buried gall bladder has been reported as 1.5% by Tiwari [2] and 1% by Talpur *et al*. [15].

Conclusion:

The various anomalies of gall bladder reported in the study will be useful in avoiding confusion with Riedel's lobe of liver during radiological procedures and preventing hepatobiliary injuries during laparoscopic cholecystectomy.

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