

DIFFERENTIAL PERITONEAL REFLECTION OF GALL BLADDER: A GROSS ANATOMICAL STUDY

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ABSTRACT: CONTEXT: Variations in the peritoneal reflections of the gallbladder are encountered during surgery and post-mortem examinations mainly form of mesentery and often have significant clinical implications, which can be life threatening at times. **AIM:** In this study, the manner of the peritoneal reflection over the gall bladder, its relative adherence to the gall bladder fossa and the relation of the fundus to the inferior margin of liver was examined. **SETTINGS AND DESIGN:** This cadaveric gross anatomical study was undertaken in the Department of Anatomy, Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha, Maharashtra, India and Subharti Medical College, Meerut, Uttar Pradesh, India, in the course a four year period i.e. 2008 to 2012, after obtaining necessary permission from the Institutional Ethical Committees. **METHODS AND MATERIAL:** It was carried out on one hundred gall bladders specimens, obtained from 10% formalin fixed cadavers during routine undergraduate students dissection The liver along with the gall bladder was retrieved from the abdominal cavity during undergraduate dissection of the abdomen and the peritoneal reflection over it was studied. **RESULTS:** Differential peritoneal reflections were observed in seven out of hundred specimens and formation of mesentery over the whole organ was found in two. In two there was mesentery over the neck and upper part of body. One the gall bladder was found floating in the gall bladder fossa but without the formation of mesentery. **CONCLUSIONS:** Differential peritoneal reflections of gall bladder were seen in seven specimens and mesentery formation to various degrees was seen in four. It was observed that peritoneal attachment of the gall bladder and the relative adherences of the viscus to the gall bladder fossa were closely associated.

KEYWORDS: Peritoneal, Mesentery, Congenital, Torsion.

INTRODUCTION: Variations in the peritoneal reflections of the gallbladder are encountered during surgery and in postmortem examination. Anomalies of gall bladder with respect to peritoneal attachments such as the viscus having a mesentery or lying freely in the peritoneal cavity,^[1] adhesions and peritoneal folds in the relation to the organ^[2] are frequented often enough, during innumerable invasive procedures. These anatomical variations are mostly congenital in origin, though mesentery of the gall bladder could be acquired as well in the advanced years of life.^[1,2]

Mesentery of the gall bladder allows it to hang freely in the gall bladder fossa which probably serves as a prelude for the development of the acute medical condition known as the Gallbladder torsion or volvulus, a rare and difficult to diagnose entity preoperatively.^[3,4] It is a potentially life threatening condition requiring urgent surgery and has a reported incidence of about 1 in 365520 hospital admissions.^[4] About 400-500 cases has been described in the literature since 1898, when Wendell^[5] first published about this condition and less than 50 has been reported in last 30 years.^[4]

MATERIALS AND METHODS: The present study was carried out on one hundred gall bladders specimens, obtained from 10% formalin fixed cadavers in the Department of Anatomy, Jawaharlal

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Nehru Medical College, Sawangi (Meghe), Wardha, Maharashtra, India and Subharti Medical College, Meerut, Uttar Pradesh, India, in the course a four year period i.e. 2008 to 2012, during routine undergraduate students dissection. It was commenced after obtaining necessary permission from the Institutional Ethical Committees. The liver along with the gall bladder was retrieved from the abdominal cavity during undergraduate dissection of the abdomen by the author in all the cases. Out of the one hundred cadavers, ninety were male and ten female. The age of the cadavers ranged between 40-75 years. None of the cadavers had any significant history of ailments pertaining to the liver and gall bladder or undergoing any sort of invasive procedures, such as endoscopic retrograde cholangiopancreatography or any sort of surgery pertaining to abdomen.

During this study, differential peritoneal reflections over the gall bladder (formation mesentery thereof) and the relative adherence of the hepatic surface of the viscus to its fossa in the visceral surface of liver was studied. Concomitantly the relationship of fundus to that of the inferior margin of the liver and the reflection of the peritoneum with regards to fundus was also examined.

RESULTS:

1. Differential peritoneal reflections of the gall bladder were observed in seven (7%) out of one hundred gall bladder specimens. They were labeled as S1 (Fig. 1), S2 (Fig. 2), S3, S4 (Fig. 3), S5, S6 (Fig. 4) and S7 (Fig. 5) and are summarized in Table 1. The manner of peritoneal reflection in the remaining ninety three (93%) was found to be usual.

2. The hepatic surface of the gall bladder excluding that of fundus (fundus lay below the inferior margin of liver) was closely adherent to its fossa, in a total of ninety three (93%) out of one hundred specimens. Out of the seven (7%) specimens with differential peritoneal reflections, in three (3%) specimens i.e. S1, S2 and S3, the gall bladder was adherent to either one or both margins of the gall bladder fossa only and free from the gall bladder fossa, in two (2%) specimens i.e. S4& S5, only the hepatic surface lower half of the body was adherent to the fossa and in another two (2%) specimens, S6 and S7, the gall bladder was completely free from the gall bladder fossa or its margins.

3. The fundus of the gall bladder was infra marginal i.e. lay below the inferior margin of the liver in a total of eighty seven (87%) specimens, including the seven where differential reflection of peritoneum was observed. In these specimens, the peritoneum covered the whole of posterior surface of the gallbladder including whole of the fundus (Fig. 6) and was reflected to the visceral surface of liver. In five (5%) specimens, the fundus was of the marginal type (Fig. 7) i.e. lay at about the inferior margin of the liver and in eight (8%) it was of supramarginal type i.e. lay above it. In both these latter types, the peritoneum was reflected onto the visceral surface of liver from the posterior surface of viscus. It covered the hepatic surface of the fundus to varying degrees. In three specimens belonging to supramarginal variety, the peritoneum was reflected from the tip of fundus to the visceral surface of liver. In all of these, the hepatic surface of whole of the gall bladder was devoid of peritoneum and adherent to the gall bladder fossa.

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Specimen no	Age in years /sex	Relationship of gall bladder with gall bladder fossa	Presence /absence of mesentery	Relation of the fundus to inferior margin of liver	changes of the liver from which specimen obtained
S1 (Fig.1)	55/M	Adherent to both right and left margin of gall bladder fossa, but totally free from it, & completely invested by peritoneum on both surfaces	Mesentery absent	Inframarginal	Gall bladder fossa fissured, ligamentum teres hepatis passing through it
S2 (Fig.2)	58/M	Adherent to at about 0.5 cm lateral to right margin of gall bladder fossa, but totally free from it & completely invested by peritoneum on both surfaces	Mesentery present along the right margin extending from neck to fundus	Inframarginal	Gall bladder fossa shallow but no change in liver parenchyma
S3	65/M	Adherent to left margin of gall bladder fossa, but totally free from it & completely invested by peritoneum on both surfaces	Mesentery absent	Inframarginal	Gall bladder fossa shallow but no changes in liver parenchyma
S4 (Fig.3)	66/M	Adherent to the gall bladder fossa partially only by the lower part of body, invested by peritoneum on posterior surface & upper part of hepatic surface of viscus	Mesentery extending from neck to upper part of body	Inframarginal	Gall bladder fossa and liver parenchyma normal

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S5	60/M	Adherent to the gall bladder fossa partially only by the lower part of body, invested by peritoneum on posterior surface & till middle of hepatic surface of viscus	Mesentery extending from neck to middle of body	Inframarginal	Gall bladder fossa and liver parenchyma normal
S6 (Fig.4)	63/M	Free from the gall bladder fossa, & completely invested by peritoneum on both surfaces.	Mesentery present along the posterior margin of the viscus extending from neck to fundus	Inframarginal	Gall bladder fossa fissured
S7 (Fig.5)	57/M	Free from the gall bladder fossa, & completely invested by peritoneum on both surfaces.	Mesentery absent	Inframarginal	Gall bladder fossa and liver parenchyma normal

Table 1: Description of the specimens with differential peritoneal reflections (s1-s7)

Figure 1: The gallbladder attached to the margin of the fissured gall bladder fossa and ligamentum teres hepatis passing through the fissure.



Fig. 1

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Figure 2: Gall bladder with mesentery (M), found loosely adherent to the liver surface near the right margin of gall bladder fossa.

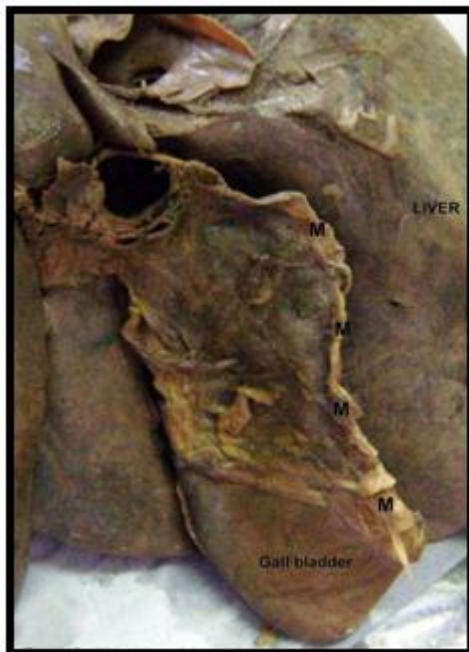


Fig. 2

Figure 3: Line diagram of the gall bladder with mesentery over the cystic duct, neck and upper part of body.

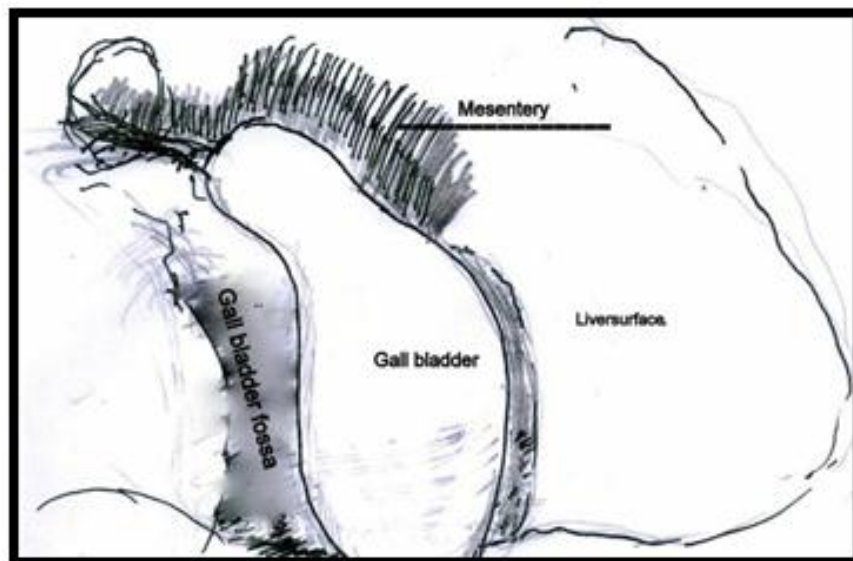


Fig. 3

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Figure 4: Gall bladder with mesentery (M) and hanging freely in fissured gall bladder fossa.



Fig. 4

Figure 5: Gall bladder suspended from the liver by the cystic pedicle, lying free in gall bladder fossa.

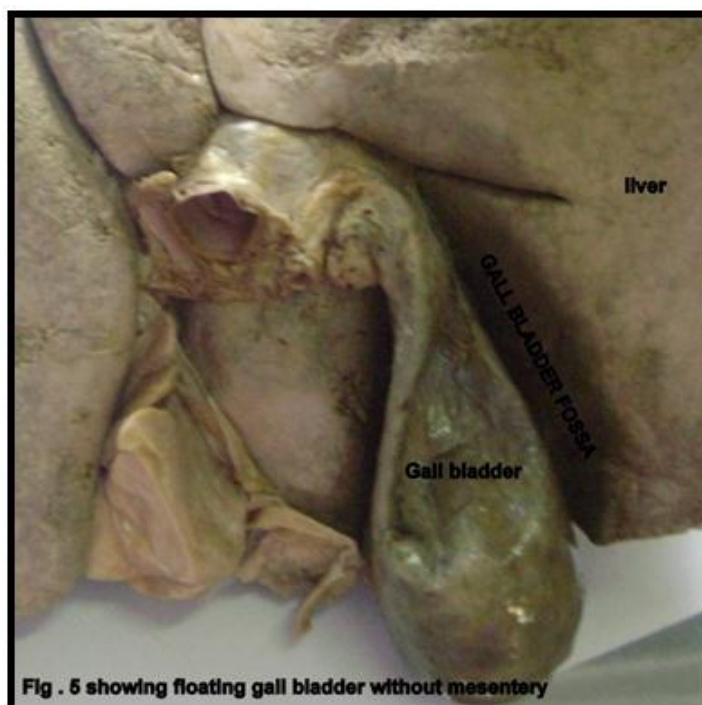


Fig. 5

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Figure 6: Non peritoneal (NP) surface of gall bladder. Dotted lines showing line of peritoneal reflection. Fundus covered by peritonem (P). GBF –gall bladder fossa.



Fig. 6

Figure 7: Gall bladder with marginal type of fundus.



Fig. 7

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DISCUSSION: Studies of peritoneal reflections of the gall bladder are very scarce in literature and consists mostly of case reports.^[1,3-23] The relative incidence is 4-5% at autopsy and dissection.^[2,3, and 23]

The gall bladder having a mesentery is mostly a congenital anomaly; however it could be acquired also in old age, especially in females.

The gallbladder is a pear shaped viscus situated in the gall bladder fossa,^[24,25,26] also known as gall bladder bed^[26] or the cystic fossa,^[27,28] on the visceral surface of right lobe of liver. It, along with the liver and the biliary ductal system develops from the hepatic diverticulum of the foregut, under the influence of major pathways in cell signaling, such as Notch, Wnt, sonic hedgehog and transforming growth factor β ^[29] in the fourth week of prenatal life. The gallbladder is described as having a fundus, body, infundibulum and neck.^[27,28,30] The fundus usually projects below the sharp inferior border of the liver to a variable length.

It touches the parietal peritoneum of the anterior abdominal wall at the tip of the ninth costal cartilage, where the transpyloric plane crosses the right costal margin i.e. at the lateral edge of the right rectus sheath.^[25,26,27,31] The fundus and the body are firmly bound to the liver by connective tissue; small cystic veins, lymphatics and bile ducts pass from liver substance into gall bladder.^[26,31] The gall bladder is covered with peritoneum, continued from the liver surfaces except where it is adherent to the gallbladder fossa. The reflection of peritoneum varies widely. At one extreme, the gall bladder may be intrahepatic^[1,25] having no peritoneal covering, whereas on the other end it may hang freely by a mesentery.

Mesentery is a double layer of peritoneum, which occurs as a result of the invagination of the peritoneum by the organ and provides a means for neurovascular communications between the organ and the body wall.^[32] In the present study, the viscus had the usual manner of peritoneal reflection, in ninety three (93 %) specimens. Differential peritoneal reflections were observed in seven (7%) specimens i.e. in S1-S7. In all of these specimens i.e. S1-S7, the gall bladder was free from the gall bladder fossa to varying degrees. Two of these specimens i.e. S1 & S3 were without mesentery and one i.e. S2 had mesentery formation over the right side of whole of the organ. In S1, the organ was adherent to both the margins of the gall bladder fossa, but totally free from the gall bladder bed, which was fissured though out and the ligamentum teres hepatis was seen passing through it. It is quite possible that these factors (i) the fossa being fissured and (ii) the ligamentum teres hepatis being a content of the gall bladder bed, could have prevented the adherence of the organ to its bed. In S2 and S3, the organ was adherent only to one of the margins of the fossa or near its vicinity. The gall bladder bed was somewhat shallow in both and it is difficult to guess whether this could have been the reason for the adherence of the organ only along one of the margins of the bed or at a little distance away from it.

Out of the remaining four specimens, in two (2%) the viscus was attached to the gall bladder fossa only in the lower part of the body, and mesentery was observed extending from the neck till upper and middle part of body i.e. in S4 & S5 respectively. Two (2%) specimens, S6 & S7 were totally free from the gall bladder fossa and its margins and completely invested by peritoneum. S6 had mesentery over whole of the organ along its posterior aspect. The gall bladder fossa was totally fissured and the mesentery was very loosely adherent to the fissure lines and while retrieval of the liver from abdominal cavity, it came out on its own very easily. S7 was found hanging freely from the liver, without any formation of mesentery. In the present study, all the cases where differential peritoneal reflection were seen, belonged to male cadavers in the age group of 47-62 years. It is

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necessary to mention here that none of the liver specimens except for two, showed any abnormality of the liver. In two liver specimens from where the gall bladders S1& S6 were obtained, there was fissuring of the gall bladder fossa and in the former, it contained the ligamentum teres hepatis. None showed atrophy of the liver.

Though most of the text books describe the fundus to be hanging down below the inferior surface of liver, in the present study we found thirteen specimens in which it lay at margin or above it. Lurge^[33] found the fundus to be supramarginal in sixty four (33%), marginal in twenty seven (13.9%) & inframarginal in 103 (53.1%) cadavers, whereas in the present study, the fundus was supra marginal in seven (7%), marginal in five (5%) and inframarginal in eighty seven (87%) specimens. The supramarginal variety is difficult to palpate even in the distended state of the viscus.^[26] Though many cases of torsion of gall bladder are reported subsequent to the viscus possessing a mesentery, there is no literature available in recent history, portraying the differential peritoneal reflections of gall bladder, its relative adherence to the gall bladder bed and relationship of the fundus to the inferior margin of liver, to the best of our knowledge.

Clinically the gall bladder hanging freely is also known floating gall bladder. It might undergo acute torsion along its mesenteric axis and vascular pedicle which contains the cystic artery.^[4] The incidence is higher in elderly females, with female to male ratio being 3:1.^[2,3,4,12,26] It has also been reported in childhood.^[4,6,14] Torsion of gall bladder often presents as acute abdomen and often mimics acute cholecystitis.^[12,22] Preoperative diagnosis is difficult and often made during emergency laparoscopy.

In this present study, variations in peritoneal reflection of gall bladder were observed in seven specimens and mesentery formation to various degrees was observed in total of four out of the one hundred specimens. It was observed that peritoneal attachment of the gall bladder and the relative adherences of the viscus to the gall bladder fossa were closely associated. Though five specimens were found to be hanging freely in the gall bladder fossa, none of them had undergone torsion and it is difficult to preempt whether they would have gone torsion or not had the subjects been alive. Variations in the peritoneal reflection in two specimens were associated with anomaly of liver in form of fissured gall bladder fossa. The anomalies found here are most likely congenital in origin as associated atrophy of liver was not found and the specimens were obtained from rather middle aged cadavers. From this study it can be said that incidence of mesentery of gall bladder is much higher in general population than diagnosed and could be associated with anomaly of the liver and gallbladder fossa.

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