



Original Research Article

Morphological Study and Variations of Gall Bladder

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ABSTRACT

Though human beings are thought to be singularly alike in their general anatomical construction, yet when come to investigate one particular region with more detail, it is surprising how frequently we meet one sort or another type of variation. This is so very true in the case of extra hepatic biliary apparatus, that according to some eminent workers, there is no normal anatomy of extra hepatic biliary tract, instead of common pattern of variation exists and it is the surgeon duty to be familiar with and recognize the normal variations when present. Major biliary complications of laparoscopic cholecystectomy may be prevented by an understanding of extra hepatic biliary ductal and arterial anatomic relationships. The common patterns of anatomic variations are important to the surgeon performing laparoscopic cholecystectomy are reviewed with respect to recently reported biliary injury during this procedure. Recommendations for delineating biliary anatomy and avoiding laparoscopic complications are reviewed.

INTRODUCTION

Human beings are thought to be singularly alike in their general anatomical construction, yet when come to investigate one particular region with more detail, it is surprising how frequently we meet one sort or another type of variation. Major biliary complications of laparoscopic cholecystectomy may be prevented by an understanding of extra hepatic biliary ductal and arterial anatomic relationships. [1,2]

Gall bladder is a reservoir for bile resembles the flask or pear shaped blind ending diverticulum attached to the common bile duct by the cystic duct. It is normally present in the Right hypochondrium partly sunk in a fossa in the right hepatic lobe's inferior surface. It extends forwards 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 hepatic surface. Occasionally it is completely invested by peritoneum and even connected to the liver by short mesentery. It typically lies in close

proximity to the duodenum, pylorus, and hepatic flexure of the right colon and right kidney. [3]

Hartmann's pouch is an out-pouching of the wall of the gallbladder at the junction of the neck of it and the cystic duct. Its identification is useful in delineating biliary anatomy when performing a cholecystectomy. It is named after Henri Albert Hartmann who first described it. Sometimes the term "Hartmann's pouch" is used to describe "Hartmann's procedure" which refers to a colon or rectal resection without an anastomosis in which a colostomy or ileostomy is created and the distal colon or rectum is left as a blind pouch. Impaction of gallstones in the Hartmann's pouch leads to Mucocoele of Gall Bladder. [4]

Cystic duct drains bile from gall bladder to common bile duct. It is about 3 to 4 cm length. It runs backwards and downwards from the neck of the gall bladder. The junction with the common hepatic ducts usually takes place immediately below the porta hepatis, however the two ducts may lie parallel to each other for some distance and on occasion may not join until they have almost

reached the duodenum. The mucus membrane of cystic duct is raised up into a spiral fold that consists of 5 to 10 irregular turns; it is continuous with a similar fold in the neck of the gall bladder. The spiral fold is believed to serve the purpose of keeping the duct open so that bile can pass through it both in and out of the gall bladder. [5]

MATERIALS AND METHODS

The dissection was performed in 30 cadavers with irrespective of age and sex in dissection Hall of Department of Anatomy, MGM Medical College, Kamothe, Navi Mumbai, India.

The institutional ethical clearance was obtained from the Ethics Committee of MGM Medical College, Navi Mumbai. After approval from ethics committee 30 embalmed human adult cadavers irrespective of sex and age were dissected for the morphological study and variation of gall bladder and cystic duct. All the cadavers were embalmed and preserved in 10% formaldehyde. The method of dissection was done as follows. Incision was taken for reflecting the skin of the anterior abdominal wall. All the layer of the anterior wall were reflected and removed. The ribs and diaphragm was cut to allow the liver to be retracted superiorly, exposing the lesser omentum. The vessels and ducts in the hepatoduodenal ligament were demonstrated, inferior boarder of liver was raised and the visceral surface of liver was identified.

The visceral surface of liver was in contact with the gallbladder and the peritoneum covering the stomach, duodenum, and colon, right kidney and right suprarenal gland were identified. The three large structures that are contained within the hepatoduodenal ligament such as bile duct, hepatic artery and portal vein were identified. A probe was used to trace the bile duct superiorly and thus the cystic duct and common hepatic duct were identified. The morphological structure and variations of gall bladder and cystic duct were studied. [11] [Fig.1,2]

RESULTS

In the present study 60% of gall bladder was found to be pear shaped and rest of the gall bladder were found to be flask shaped, tubal shaped and hour glass shaped. The colour of the gall bladder was found to be 56.7% green, 20 % light green, 10 %

dark green and 13.3% brown. No reference was found in the literature regarding various colour of gall bladder. 33.33 % fundus of gall bladder was found to be extending within the inferior boarder, 33.33 % extended beyond the inferior boarder and 33.33 % fundus of gall bladder extended up to the inferior boarder of liver.

GALL BLADDER

Colour of Gall Bladder

The color of gall bladder was found to be green, light green, dark green and brown. In 17 (56.7%) out of 30 specimens, the color of gall bladder was green. The findings are depicted in table-1 and 2 and shown in fig.3 (A-D) and 7.

Shape of Gall Bladder

The gall bladders were found to be pear shaped, flask shaped, tubal shaped and hourglass shaped. In 18 (60%) out of 30 specimen the gall bladder were pear shaped. The findings are depicted in table-1 and 3 and shown in fig.3 (A-D) and 6.

Length of Gall Bladder

The length of gall bladder varied from 39.55 mm to 90.40 mm. In 17 specimens out of 30, the length of gall bladder ranged between 50.00 mm to 59.99 mm. The mean length of gall bladder was found to be 61.01 ± 2.10 mm. The findings are depicted in table-1 and 8, fig.8.

Breadth of Gall Bladder

The breadth of gall bladder varied between 7.03 mm to 52.20 mm. In 13 specimens out of 30, the breadth of gall bladder ranged between 20.00mm to 29.99mm. The mean breadth of gall bladder was found to be 30.08 ± 2.06 mm. The findings are depicted in table 1 and 8, fig.9.

The Correlation between Length and Breadth of Gall Bladder

The length of gall bladder was found to be 61.01 ± 2.10 mm in comparison to breadth which was found to be 30.08 ± 2.06 mm. The findings are depicted in table-5.

Extension of Gall Bladder in Respect to Inferior Boarder of Liver

In the present study out of 30 specimen of the gall bladder in 10 specimens (33.33%) of gall bladder the Fundus was found to be extending beyond the

inferior border of liver. In other 10 specimens (33.33%) the Fundus of gall bladder was found to be extending within the inferior border of liver and in the remaining 10 specimens (33.33%) the Fundus of gall bladder was found to be extending up to the inferior border of liver. The findings are depicted in table –7 and shown in fig.10.

Hartmann's Pouch Associated with Gall Bladder

In the present study 40% of the gall bladders were seen to have presence of Hartmann's pouch whereas in remains 60% of them there was absence of Hartmann's pouch. The findings are depicted in table -6 and shown in fig.4 (A-B), and 11.

The Length of Cystic Duct

The length of cystic duct varied between 12.20 mm to 29.50 mm. In 19 specimens out of 30, the length of cystic duct ranged between 10.00 mm to 19.99 mm. The mean length of cystic duct is 19.09 ± 0.96 mm. The findings are depicted in table – 1 and shown in fig. 5 (A-B) and 13.

DISCUSSION

It is quite conceivable that any arrest or deviation from the normal embryological developmental process may result in some sort of malformation of the gall bladder and biliary systems [1]. The gall bladder varies greatly in size and shape and it may be impossible sometimes to distinguish between various parts described. The relaxed gall bladder was approximately 100mm long and 35 mm in diameter 29 found by Turner MA et al.[12] and dimension of gall bladder was 50mm to 120 mm. In 80% the length ranged between 70 – 100 mm by Rajguru J et al. [1] and most of the specimens were consistent with those of Chari and Shah (2008). [13]. The breadth of gall bladder was found to range between 25 mm to 50 mm by Rajguru J et al. [1] which is similar to that found by Chari and Shah (2008). [13]

In the present study the length of gall bladder varied from 39.55 mm to 90.40 mm with the average length of 61.01 ± 2.10 mm and breadth varied from 7.03 to 52.20 mm with the average breadth of 30.08 ± 2.06 mm. Gore RM et al.[14] stated that the size of the gall bladder might increase after vagotomy, in diabetes because autoimmune neuropathy, in pregnancy, in patient with sickle cell disease, after cystic duct or

common duct obstruction and in extreme obese people whereas micro gall bladder was usually seen in association with cystic fibrosis. In his study Rajguru J et al [1] found that 85% of gall bladder were pear shaped and were in consonance with the findings of many workers like Moore and Dalley 2006 [15]. Chari and Shah (2008) [13], cylindrical shape has been observed by Hollingshead 1983, Hour glass shaped gall bladder has been reported by Shafer 2005, retort shaped gall bladder has been described by Meilstrup et al 1991 [16] in a sonographic study.

In the present study 60% of gall bladder was found to be pear shaped and rest of the gall bladder were found to be flask shaped, tubal shaped and hour glass shaped.

In our study colour of the gall bladder was found to be 56.7% green, 20 % light green, 10 % dark green and 13.3% brown. No reference was found in the literature regarding various colour of gall bladder.

In the present study 33.33 % Fundus of gall bladder was found to be extending within the inferior boarder, 33.33 % extended beyond the inferior boarder and 33.33 % Fundus of gall bladder extended up to the inferior boarder of liver. No reference was found to in the literature regarding extension of Fundus of gall bladder in relation to inferior boarder of liver. The folded Fundus of gall bladder also referred to as the Phrygian cap was reported in 3 % - 7.5 % cases in the study by Lichtenstein and Nicosia (1995) [20], they are considered to be formed due to disproportion between the size of gall bladder and that of bladder bed , but without any pathological significance. Deutsch 1986 [21] found this anomaly in 0.33 % and considered it as non developed form of congenital septum. Gore et al. [14] found it 1 % - 6 % of the population observed as fold or septum the body and Fundus. Rajguru J et al. [1] found it in 6.67 % a specimen which was similar to that of Lichtenstein and Nicosia [20].

In the present study no cases of folded Fundus were found. Mathur RC et al found that 0.1 % of septate gall bladder which has been rarely documented [19]. In our study there no specimen of Septate gall bladder were found.

In our study length of cystic duct varied between 12.20 mm to 29.50 mm with mean length of 19.09

mm \pm 0.96 mm. The length of cystic duct found by Cachoeira et al. [18] varied between 7 mm to 39 mm with average length of 19 mm, slightly below the average found by Turner et al. [12] which was around 20 to 40 mm. According to Caroli- Bosc et al.[22] there is an association between the size of cystic duct and its left lateral attachment to the gall bladder so that most laterally attached ducts and had more than 30 mm in length, whereas the left attachment of the cystic duct would be associated with a greater incidence of bile stones. Rajguru J et al. studied on 60 gall bladder showed that, the average length of gall bladder was 7-10 cm (80%), breadth 3-3.5 cm(40%), cylindrical shape 85% and folded neck and folded Fundus were in 11% [1]. Mahto NK reported that Gallbladder are rare variations associated with extra hepatic biliary system consists 0.1% of population with a wide variety of malformations pertaining to its size, shape, number and position [5]. Talpur KA, et al. reported that out of 300 cases, variations of cystic duct are 4.33% and of gall bladder is 2% [19]. Khan AH et al. reported that out of 100 cases, there are 6% cases of Moynihan's, 1% of double cystic duct and 15 case of long cystic duct. [6] van Ejick FC et al. reported that total 98 gall bladder were examined , 49 obtained after laproscopic and 49 were obtained after postmortem examination , among them 51 gall bladders seen to have Hartmann's pouch and rest of gall bladders were absence of Hartmann's pouch. There is a significant association between the presence of Hartmann's pouch and stones ($p < 0.05$) [8]. Futura G et al. reported that out of 110 specimen, 51% of specimen had supra marginal type of gall bladder and neck and infundibulum of the gall bladder were shorter in the present report compared to reports in other populations [9]. Losanoff JE et al. reported that during operation , a gangrenous gall bladder was found with omentum, hepatic falciform ligament, the antrum of the stomach, the 1st part of duodenum and the head of the pancreas being adherent to it. [10]

CONCLUSION

Congenital anomalies and normal variants of gall bladder and cystic duct are not common but may be of significance during laparoscopic surgery as failure to recognize those leads to iatrogenic injuries and can increase morbidity and mortality. The color of gall bladders studied were green, light green, dark green and brown out of which 56.7%

were found to be green. 60% were pear shaped compared with flask, hour glass and tubal shape of gall bladder. In 56.67% of specimens, the length of gall bladder ranged between 50.00 mm to 59.99 mm and the mean length of gall bladder was found to be 61.01 ± 2.10 mm. In 43.33 specimens, the breadth of gall bladder ranged between 20.00mm to 29.99mm and the mean breadth of gall bladder was found to be 30.08 ± 2.06 mm. Out of 30 specimen of the gall bladder studied, in 10 specimens (33.33%) the Fundus of gall bladder were found to be extending beyond the inferior border of liver, in other 10 specimens (33.33%) the Fundus of gall bladder was found to be extending within the inferior border of liver and in the remaining 10 specimens (33.33%) the Fundus of gall bladder was found to be extending up to the inferior border of liver and 40% of the gall bladders were seen to have presence of Hartmann's pouch where is remains 60% of them showed the absence of Hartmann's pouch. In 63.33%, the length of cystic duct ranged between 10.00 mm to 19.99 mm the mean length of cystic duct is 19.09 ± 0.96 mm.

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Fig.1. Dissecting materials

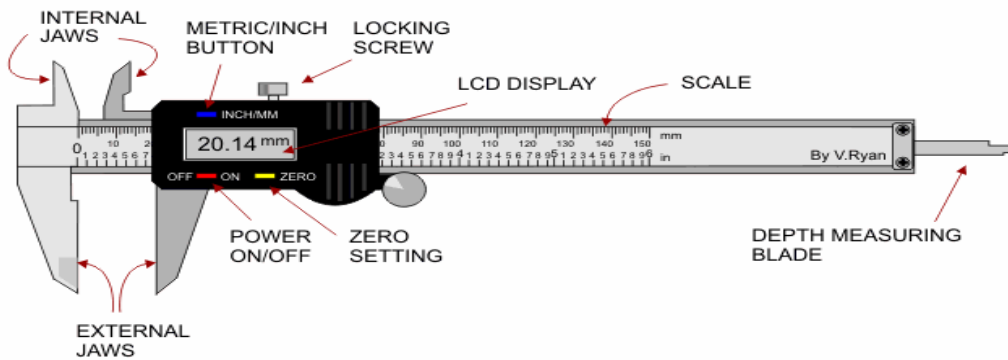


Fig.2. Vernier caliper



Fig.3. Dissection of gall bladder.

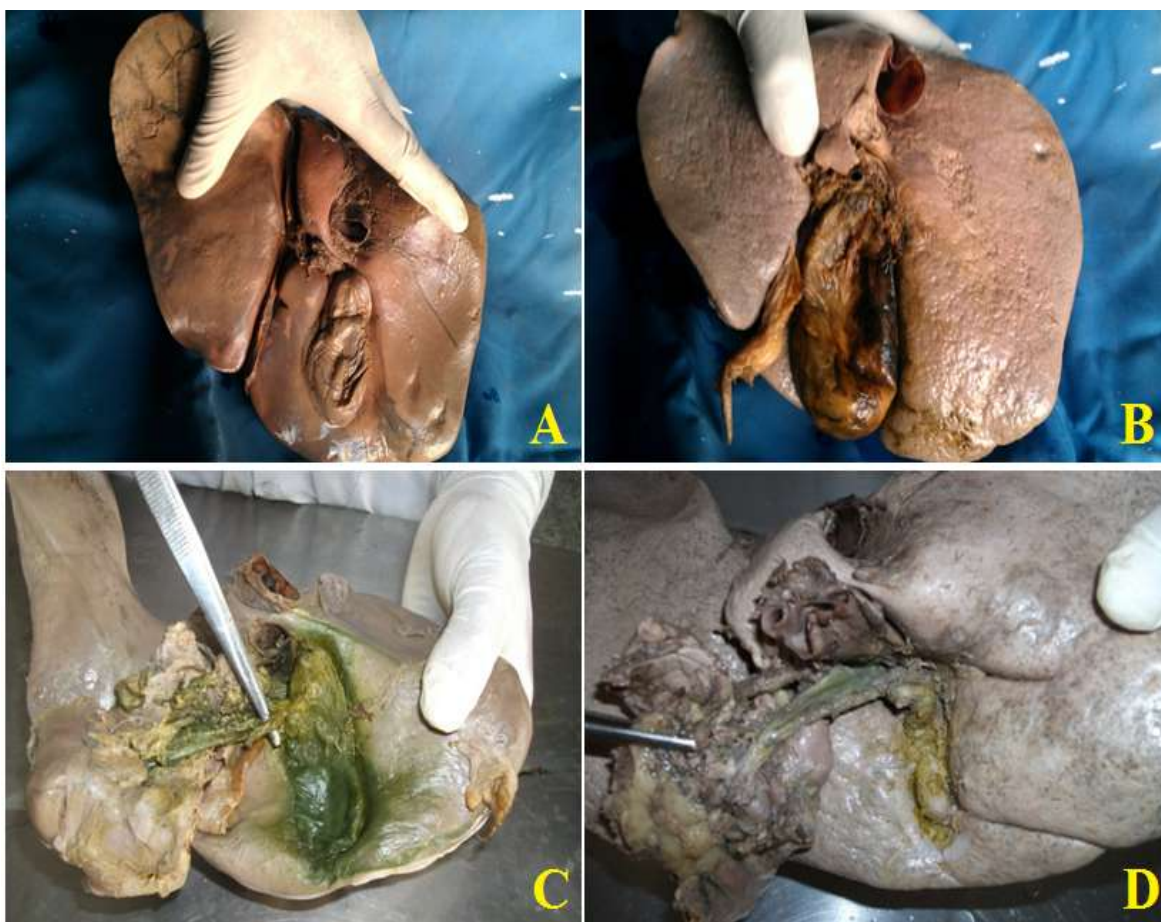


Fig.3 (A-D). Shows colour and shape of gall bladder. A: Brown colour and hour glass shaped gall bladder, B: Light green colour & flask shape gall bladder, C: Dark green color gall bladder, D: Narrow and tubal shape gall bladder

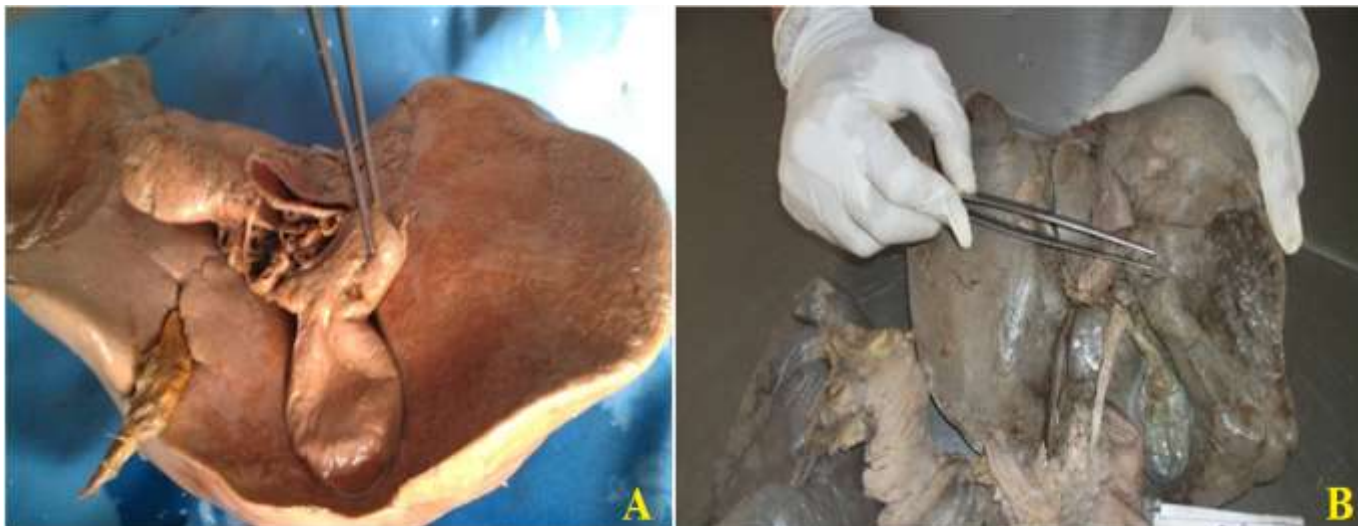


Fig.4 (A-B). Shows Hartmann's Pouch. A: Presence of Hartmann's Pouch. B: Absence of Hartmann's Pouch.



Fig. 5 (A-B). Shows cystic duct. A: Short Cystic Duct, B: Long Cystic Duct.

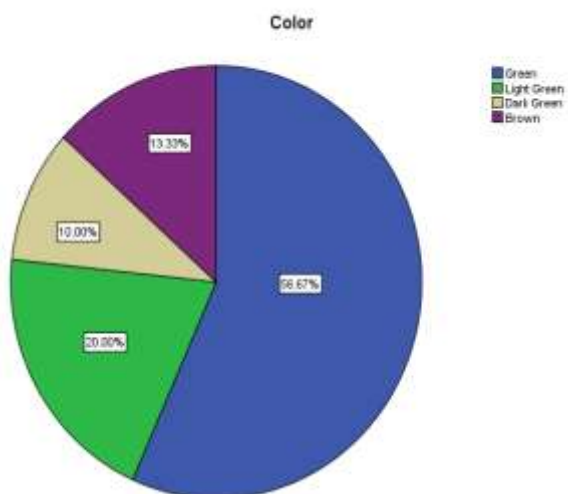


Fig.6. Pie chart of different shape of gall bladder

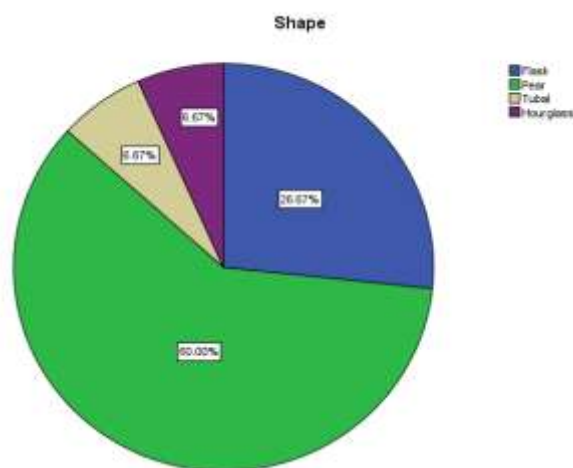


Fig.7. Pie chart of different colour of gall bladder

Table 1. Shows observation of the study.

S. N.	Gall bladder						Cystic duct
	Color	Shape	Length (mm)	Breadth (mm)	Extension	Hartmann's Pouch	Length (mm)
1.	Green	Flask	90.40	52.20	B. I. B.	Present	24.31
2.	Light Green	Pear	59.42	38.12	W.I. B.	Absent	20.11
3.	Green	Hourglass	62.21	29.11	A. I.B.	Present	15.20
4.	Green	Pear	58.00	30.60	A. I.B.	Present	18.60
5.	Green	Pear	56.90	26.90	A. I.B.	Absent	29.50
6.	Brown	Tubal	39.55	7.03	W. I.B.	Present	21.22
7.	Green	Pear	54.17	29.45	A. I. B.	Absent	13.86
8.	Dark green	Flask	75.83	34.50	B. I. B.	Present	11.21
9.	Brown	Pear	53.60	29.90	W. I.B.	Absent	16.14
10.	Light green	Pear	54.50	23.90	W. I.B	Absent	19.81
11.	Dark green	Flask	71.10	50.77	B. I. B.	Absent	26.91
12.	Green	Flask	68.81	24.93	B.I. B.	Absent	12.42
13.	Green	Pear	58.11	19.56	W. I.B	Present	15.85
14.	Light green	Pear	59.42	38.12	W. I. B.	Absent	20.11
15.	Green	Flask	90.40	52.20	B. I. B.	Present	24.31
16.	Green	Pear	56.90	26.80	A.I.B.	Absent	29.50
17.	Green	Pear	54.17	29.45	A. I.B.	Absent	13.86
18.	Dark green	Flask	75.83	34.45	B. I.B.	Present	11.21
19.	Light green	Pear	54.50	23.90	B.I.B.	Absent	19.81
20.	Green	Hourglass	62.21	29.11	A. I.B.	Present	15.20
21.	Green	Pear	58.00	36.60	A. I. B.	Present	18.60
22.	Brown	Tubal	39.55	7.03	W.I. B.	Present	21.22
23.	Brown	Pear	53.60	29.90	W.I. B.	Absent	16.14
24.	Dark green	Flask	71.10	50.17	B. I. B.	Absent	26.11
25.	Light green	Pear	54.25	22.76	B. I. B.	Absent	19.80
26.	Green	Flask	68.60	24.50	B. I. B.	Absent	12.20
27.	Green	Pear	58.10	18.60	W. I.B.	Absent	15.75
28.	Green	Pear	56.25	25.48	A. I. B.	Absent	27.69
29.	Green	Pear	57.34	37,13	A. I. B.	Present	18.60
30.	Green	Pear	57.66	19.24	W. I.B.	Absent	17.63

A.I.B= At inferior border, B.I.B= Beyond inferior border, W.I.B= Within inferior border

Table 2. Percentage showing the different colour of gall bladder

Color		
Color	Frequency	Percent (%)
Green	17	56.7
Light Green	6	20.0
Dark Green	3	10.0
Brown	4	13.3
Total	30	100.0

Table 3. Percentage showing the different shape of gall bladder

Shape		
Shape	Frequency	Percent (%)
Flask	8	26.7
Pear	18	60.0
Tubal	2	6.7
Hourglass	2	6.7
Total	30	100

Table 4. Percentage of different shape of gall bladder

Shape		
Shape	Frequency	Percent (%)
Flask	8	26.7
Pear	18	60.0
Tubal	2	6.7
Hourglass	2	6.7
Total	30	100

Table 5. Depicted the correlation between length and breadth of gall bladder correlations

		Gall Bladder (L)	Gall Bladder (B)
Gall Bladder (Length)	Pearson Correlation	1	.781**
	Sig. (2-tailed)		.000
	N	30	30
Gall Bladder (Breadth)	Pearson Correlation	.781**	1
	Sig. (2-tailed)	.000	
	N	30	30

Table 6. Frequency of Hartmann’s pouch.

Hartmann’s pouch	Frequency	Percent (%)
Absent	18	60.0
Present	12	40.0
Total	30	100.0

Table 7. Percentage showing the extension of gall bladder

Extension	Frequency	Percent (%)
Within inferior border	10	33.3
At inferior border	10	33.3
Beyond inferior border	10	33.3
Total	30	100.0

Table 8. Depicted the statistics analysis

Descriptive Statistics						
Parameter	N	Range	Mean		Std. Deviation	Variance
L=Length B=Breadth	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Gall Bladder (L)	30	50.85	61.0160	2.10851	11.54877	133.374
Gall Bladder (B)	30	45.17	30.0803	2.06938	11.33448	128.470
Cystic Duct (L)	30	18.29	19.0960	.96571	5.28938	27.978

Table 9. The length, breadth and shape of gall bladder found by various workers

Sr. No.	Researcher name	Year	Length (mm)	Breadth (mm)	Shape
1.	McGregor AL et al. [23]	1986	75-100	-	-
2.	Turner MA et al. [12]	2000	100	35	Elliptical
3.	Moore KL et al. [15]	2006	70 – 100	-	Pear
4.	Chari RS et al. [13]	2008	70 – 100	25	Pear
5.	Vakili K et al. [24]	2008	70-100	40	Pyriform
6.	Standring S [25]	2008	70 – 100	-	Flask
7.	Rajguru J et al. [1]	2012	50- 120	25- 50	85% Pear 5% Flask 3.3% Cylindreal 3.3% Hourglas 3.3% Retort
8.	Present study	2013	39.55- 90.40	7.03- 52	60% Pear 26.7% Flask 6.7% Tubal 6.7% Hourglass

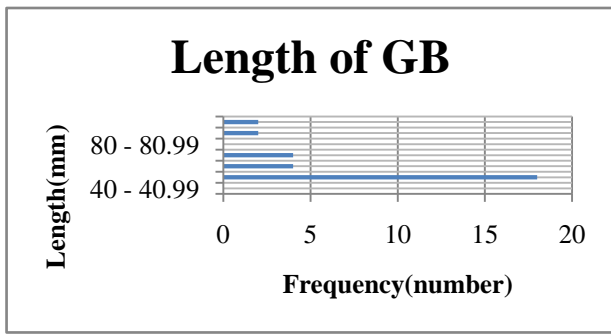


Fig.8. Length of gall bladder

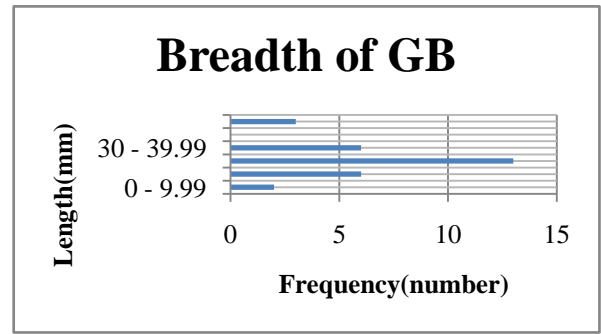


Fig.9. Breadth of gall bladder

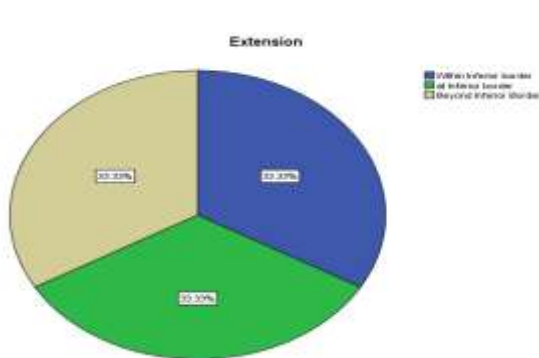


Fig.10. Pie chart of extension of gall bladder

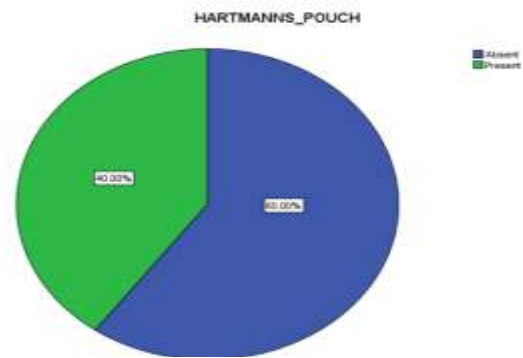


Fig.11. Pie chart showing the presence and absence of Hartmann's pouch

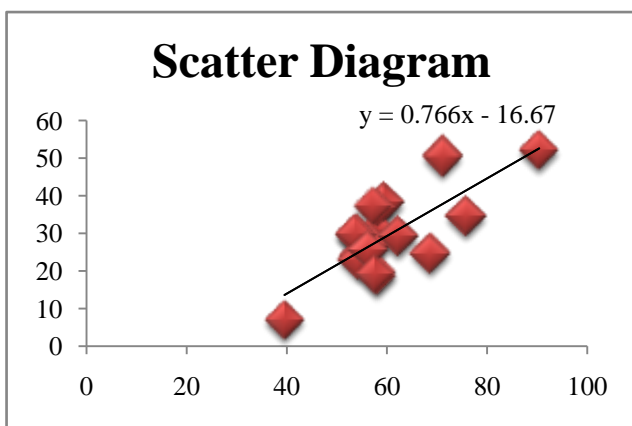


Fig.12. scattered diagram

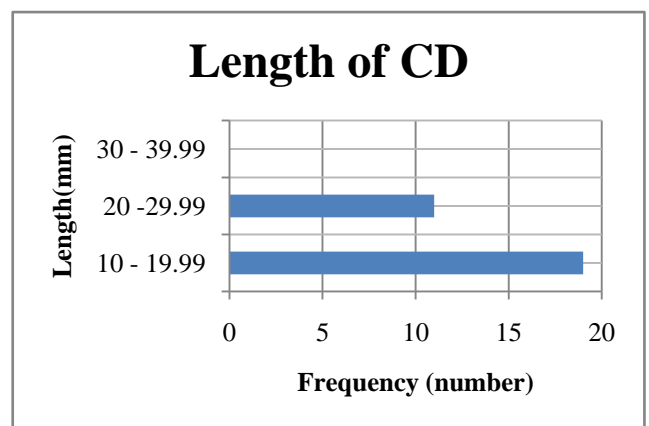


Fig.13. Depicted the length of Cystic Duct

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