Original Article

Study of Adult Cadaveric Gall Bladder with its Variations in Relation to Age and Sex of Bangladeshi People

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Abstract

Introduction: *The gallbladder is a pear-shaped, blind-ending diverticulum attached to the common bile duct by the cystic duct[1]. It stores and concentrates bile. In life it is grey–blue in colour and is usually firmly attached by connective tissue to the inferior surface of the right lobe of the liver. It usually lies in a shallow fossa (fossa for the gallbladder) on the visceral surface of the right lobe of the liver, covered by peritoneum continued from the surface of the liver. The presence of anatomical variations contributes to the occurrence of major postoperative complications especially biliary injuries during cholecystectomy. Precise knowledge about the variants of gallbladders is, therefore, of utmost importance before performing radiological, surgical or laparoscopic procedures.*

Methods: *This cross-sectional descriptive study was conducted over a period of one year from January 2021 to December 2021 in the department of Anatomy, Rajshahi medical college, Rajshahi in collaboration with Forensic Medicine Department of both RMC, Rajshahi and Shaheed Tajuddin Ahmad Medical College, Gazipur. After fulfilling the inclusion criteria, data were collected purposively with the help of a structured questionnaire by observation of 68 cadaveric gallbladders for their morphological features as well as measuring some morphological parameters with the help of respective research instruments. The data were analyzed via SPSS (version 25.0). Statistical significance was evaluated as appropriate probability level $p < 0.05$ or .001 for all tests.*

Results: *In this study Mean (± SD) age of the cadavers was 40.49 (± 11.71) years. Among the cadavers, 3/5th of them were female (60%) and remaining 2/5th of them were male (40%). Maximum (86.8%) shape of the gallbladders were pear shaped. Mean (±SD) value of maximum length of cadaveric gallbladders were 6.99 (± 1.33) cm. It reveals that regarding presence of folding of fundus only few (2.9%) gallbladders had folding at the level of fundus present anteriorly but maximum (97.1%) had no folding at fundus level. At the level of neck of the gallbladders no folding present. Hartman's pouch was absent in all (100%) of the gallbladders.*

Regarding gallbladder fossa on the under surface of liver were present in all (100%) visceral surface of liver.

Half (50%) of the fundus of the gallbladders were extended below inferior border of liver and just more than one 1/4th (27.9%) fundus were at the level of inferior border of liver.

The relation between age group of the cadaveric respondents and shape of gallbladders (n=68). It reveals that proportion of pear shape gallbladders were more among the 20-40 years old cadavers (89.2%) than 41-65 years old cadavers (83.9%). Again, cylindrical shape gallbladders were also proportionately high among 20-40 years old cadavers than 41-65 years old cadavers (10.8% and 9.7% respectively). But irregular shape gall bladders were proportionately more among the 41-65 years old cadavers than 20-40 years old cadavers (6.5% and 0.0 % respectively). The relation between age category of the cadaveric respondents and extension of fundus of the gallbladders in respect of inferior border of liver (n=68). It reveals that proportion of extension of fundus of gallbladders above inferior border of livers were more among the 41-65 years old cadavers (29.0 %) than 20-40 years old cadavers (16.2%). But extension of fundus of gallbladders both at the level and below the level of inferior border of liver were proportionately high among 20-40 years old cadavers (54.1% & 29.7% respectively) than 41-65 years old cadavers (45.2 % and 25.8 % respectively).

Conclusion: *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. Findings this study will help to understand and identify possible variations of GB morphology.*

Keywords: *Cadaveric gall bladder, Morphological variations and relations.*

Introduction

The gallbladder is a pear-shaped, blind-ending diverticulum attached to the common bile duct by the cystic duct[1]. It stores and concentrates bile. In life it is grey–blue in colour and is usually firmly attached by connective tissue to the inferior surface of the right lobe of the liver. It usually lies in a shallow fossa (fossa for the gallbladder) on the visceral surface of the right lobe of the liver, covered by peritoneum continued from the surface of the liver. The presence of anatomical variations contributes to the occurrence of major postoperative complications especially biliary injuries during cholecystectomy. Precise knowledge about the variants of gallbladders is, therefore, of utmost importance before performing radiological, surgical or laparoscopic procedures.

It usually lies on the visceral surface of the right lobe of the liver in gallbladder fossa between the right and quadrate lobes[2].

The gall bladder is 7–10 cm long, 3 cm broad at its widest part and 30–50 ml in capacity[3]. It has fundus, body and neck from above, downwards and forwards. The fundus is intraperitoneal and usually extends beyond the inferior border of the liver to come in contact with the anterior abdominal wall behind the right ninth costal cartilage. The body is directed upwards, backwards and to the left; near the right end of the porta hepatis, it is continuous with the gall bladder neck. The neck is narrow, projecting forwards and then abruptly back and downwards, to become the cystic duct[4].

On the ventral aspect of the gall bladder just proximal to the neck, a dilatation usually present known as Hartmann's pouch. Gallstones commonly impact in this sac [5,6,7,8]. It may also be involved in several other pathologies. If a peptic duodenal ulcer ruptures, a false passage may form between the infundibulum and the superior part of the duodenum, allowing gallstones to enter the duodenum[9]. Hartmann's pouch is responsible for adhesion between the neck and cystic duct even with the common bile duct in inflammatory condition [10].

Precise knowledge about the variants of gall bladder is, therefore, of utmost importance before performing radiological, surgical or laparoscopic procedures. Despite this, not much study has been done in Bangladeshi population. Therefore, the present study was conducted on the cadaveric gallbladders of Bangladeshi people to observe the the morphological

variations of cadaveric gallbladders in relation to age and sex of the cadavers. That will provide valuable predictors for Knowledge of relevant anatomy would be important for the safe execution of any operative procedure. Specifically, in the context of a cholecystectomy, it has been recognized since long that misinterpretation of normal anatomy as well as the presence of anatomical variations contribute to the occurrence of major postoperative complications especially biliary injuries [11]. Such injuries in turn can cause significant morbidity and occasionally even mortality. They are also one of the commonest causes of litigation against abdominal surgeons in the developed world[12]. So, knowing about the position, shape, size and thickness of gallbladder wall have clinical implication. There is no widely available published data on morphological variations of gallbladder of autopsy people and also morphological variations of gallbladder in different ages and sexes in Bangladeshi people. With the above background and rationale, the present study was aimed at to study the anatomical features (morphology) of human gallbladder (autopsied) to establish a normal standard for Bangladeshi people and to find out any variation of morphology of gallbladder in relation to age and sex.

Materials and Methods

It was a cross-sectional type of descriptive study. This study was conducted over a period of one year from January 2021 to December 2021. The study was carried out in the department of Anatomy, Rajshahi medical college, Rajshahi in collaboration with Forensic Medicine Department of RMC, Rajshahi and Shaheed Tajuddin Ahmad Medical College, Gazipur.

Cadaveric donors provided by Forensic Medicine Department of Shaheed Tajuddin Ahmad Medical College during the above-mentioned study period were the study population. Purposive technique had adopted in this study. Data were collected using a structured questionnaire, with the help of following instruments morphological measurement were taken (Sliding vernier calipers, Inextensible thread).

Data were collected by using structured questionnaire by observation of external morphological features of gall bladder as well as measuring different morphometric parameters of cadaveric gallbladders with the help of respective instruments.

The maximum length will be measured from the porta hepatis to the mid-point of the fundus (Figure 1 & 2) and the maximum transverse diameter (Figure 3 & 4) will be measured from the porta hepatis (Figure 5) as well as from the inferior border of the liver (Figure 6) using inextensible thread & vernier caliper in centimeters. The shape and any variation in external appearance of gall bladder will be noted. Then the thickness of the gall bladder wall will be measured in centimeters at the maximum transverse diameter of the fundus, body and neck region of the gallbladder with the help of Vernier caliper (Figure 5, 6,7). For taking measurements the non-peritoneal surface will not be chosen as it is irregular. All measurements had taken with using respective research instruments approximately at same temperature and fix humidity to avoid any bias due to environmental changes. All linear measurements will be made in cm on the intact parts of gallbladders.

The data had analyzed via Statistical Package for the Social Sciences (SPSS, version 24.0, Chicago, IL) software. The level of significance was set at 5% and p-value < 0.05 or <.001 were considered as statically significant.

Figure 1: Maximum length of gall bladder

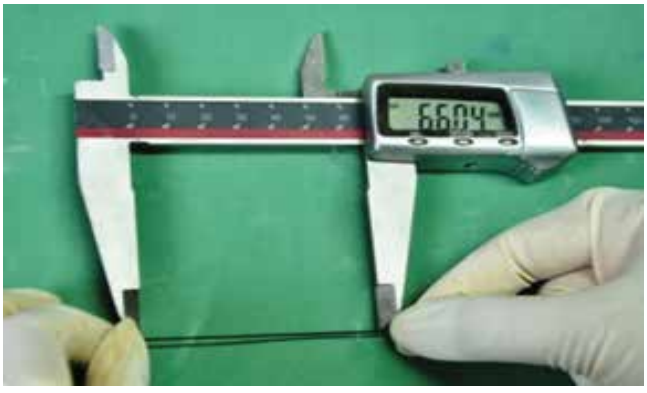

Figure 2: Maximum length of gall bladder

Figure 3: Maximum transverse diameter

Figure 4: Maximum transverse diameter

Figure 5: Thickness of the gall bladder

Figure 6: Thickness of the gall bladder

Figure 7: Thickness of the gall bladder

Results

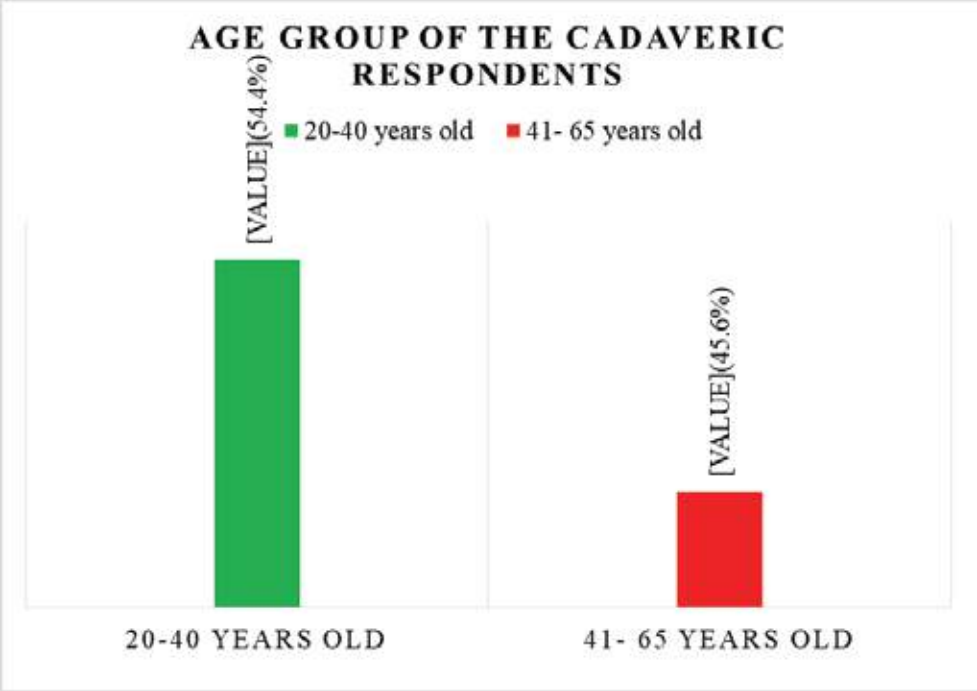

Figure 10: Distribution of the cadaveric respondents according to their age group (n=68)

Figure 10 showed the distribution of the cadaver respondents according to their age group. It reveals that among the cadavers proportionately higher number were belongs to age group in between 20 to 40 years old (54.40%) than 41 to 65 years old age group (45.60%). Mean (± SD) age of the cadavers was 40.49 (± 11.71) years. Minimum and maximum age of the cadavers were 20 years and 65 years respectively.

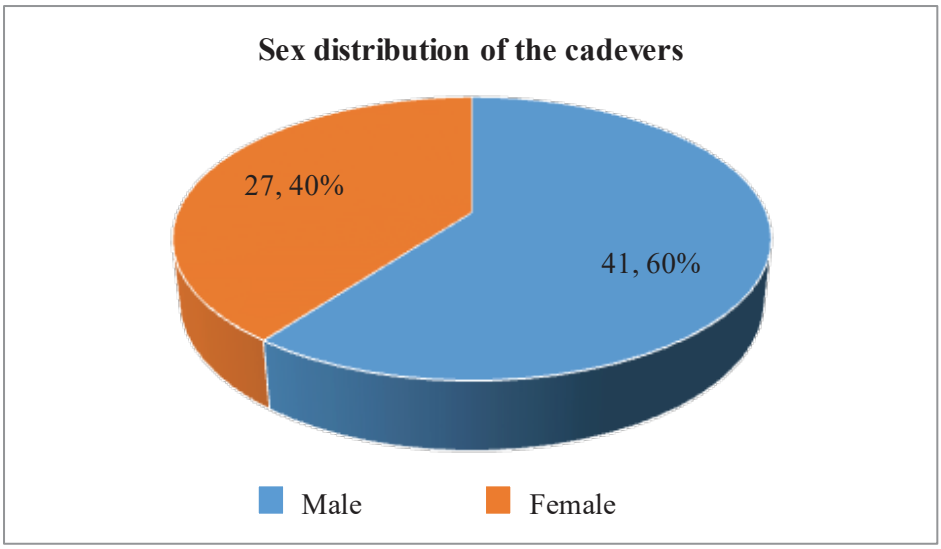

Figure 11: Sex distribution of the cadavers (n=68).

Figure 11 showed the distribution of the cadaver respondents according to their sex .It reveals that among the cadavers, 23/5thof them were male (60%) and 2/5th of them were female (40%) respondents.

Table I: Sex distribution of the cadavers according to their age category (n=68).

Age category of the cadavers	Gender of the cadavers		Total
	Male	Female	
20 -40 years old (n=37)	23 (62.2%)	14 (37.8%)	37 (100.0%)
41 -65 ye ars old (n=31)	18 (58.1%)	13 (41.9%)	31 (100.0%)
Total	41 (60.3%)	27 (39.7%)	68 (100.0%)

Table I showed the sex distribution of the cadavers according to their age category (n=68). It reveals that in both age group males were proportionately higher than female cadavers (62.2% vs 37.8% in 20 to 40 years old and 58.1% vs 41.9% in 41 to 65 years old age group). Among the male cadavers proportionately higher in age category 20 to 40 years old than 41 to 65 years old cadavers (62.2% and 58.1% respectively). Regarding female cadavers, in the age group 41 to 65 years were proportionately higher than 20 to 40 years older age group (41.9% and 37.8 % respectively).

Table II: Relation between age group of the cadaveric respondents and shape of gallbladders (n = 68).

Age group of the cadaver	Shape of the gall bladder			Total
	Pear Shaped	Cylindrical	Irregular	
20 -40 years old (n=37)	33 (89.2%)	4 (10.8%)	0(0.0%)	37(100.0%)
41 -65 years old(n=31)	26 (83.9%)	3 (9.7%)	2 (6.5%)	31 (100.0%)
Total	**59 (86.8%)**	**7 (10.3%)**	**2 (2.9%)**	**68 (100.0%)**

Table II showed the relation between age group of the cadaveric respondents and shape of gallbladders (n=68). It reveals that proportion of pear shape gallbladders were more among the 20-40 years old cadavers (89.2%) than 41-65 years old cadavers (83.9%). Again, cylindrical shape gallbladders were also proportionately high among 20-40 years old cadavers than 41-65 years old cadavers (10.8% and 9.7% respectively). But irregular shape gall bladders were proportionately more among the 41-65 years old cadavers than 20-40 years old cadavers (6.5% and 0.0 % respectively).

Table III: Distribution of extension of the fundus of gallbladders in relation to inferior border of liver (n=68).

Extension of the fundus of gallbladders	Frequency	Percent
Above the inferior border of liver	15	22.1
Below the inferior border of liver	34	50.0
At the level of the inferior border of liver	19	27.9
Total	**68**	**100.0**

Table III showed the distribution of extension of the fundus of gallbladders in relation to inferior border of liver. It reveals that about half (50%) of the fundus of the gallbladders were extended below inferior border of liver and just more than one 1/4th (27.9%) fundus were at the level of inferior border of liver. Again, more than 1/5th (22.1%) of the fundus of gallbladders were above the inferior border of liver.

Table IV: Relation between age group of the cadaveric respondents and extension of fundus of the gallbladders in respect of inferior border of liver (n = 68).

Age group of the cadavers	Extension of fundus of the gallbladders			Total
	Above the inferior border of liver	Below the inferior border of liver	At the level of inferior border of liver	
20 -40 years old (n=37)	6 (16.2%)	20 (54.1 %)	11(29.7%)	37(100.0%)
41 -65 years o ld (n=31)	9 (29.0%)	14 (45.2 %)	8 (25.8 %)	31 (100.0%)
Total	**15 (22.1%)**	**34 (50.0 %)**	**19 (27.9%)**	**68 (100.0%)**

Table IV showed the relation between age category of the cadaveric respondents and extension of fundus of the gallbladders in respect of inferior border of liver (n=68). It reveals that proportion of extension of fundus of gallbladders above inferior border of livers were more among the 41-65 years old cadavers (29.0 %) than 20-40 years old cadavers (16.2%). But extension of fundus of gallbladders both at the level and below the level of inferior border of liver were proportionately high among 20-40 years old cadavers (54.1% & 29.7% respectively) than 41-65 years old cadavers (45.2 % and 25.8 % respectively). A chi-square test for independence with $\alpha = .05$ was used to assess whether age category of the respondents related to extension of fundus of the gallbladders in relation to inferior border of liver. The relation between variables were statistically not significant ($\chi 2 = 1.62$, df= 2, $p>.05$).

Table V: Relation between gender of the cadaveric respondents and shape of the gallbladders (n = 68).

Gender of the cadavers	Shape of the gallbladders			Total
	Pear Shaped	Cylindrical	Irregular	
Male (n=41)	36 (87.8 %)	4 (9.8%)	1 (2.4 %)	41 (100.0%)
Female (n=27)	23 (85.2 %)	3 (11.1 %)	1 (3.7 %)	27 (100.0%)
Total	**59 (86.8%)**	**7 (10.3%)**	**2 (2.9%)**	**68 (100.0%)**

Table V showed the relation between age category of the cadaveric respondents and shape of gallbladders (n=68). It reveals that proportion of pear shape gallbladders were more among the male cadavers (87.8 %) than female cadavers (85.2 %). About cylindrical shape gallbladders were also proportionately high among female cadavers than male cadavers (11.1 % and 9.8 % respectively). Again, irregular shape gallbladders were proportionately more among the female cadavers than male cadavers (3.7 % and 2.4 % respectively) A chi-square test for independence with $\alpha = .05$ was used to assess whether gender of the respondents related to shape of the gallbladders. The relation between variables were statistically not significant ($\chi 2 = 0.13$, df= 2, $p>.05$).

Table VI: Relation between gender of the cadaveric respondents and extension of fundus of the gallbladders in respect of inferior border of liver (n = 68).

Gender of the cadavers	Extension of fundus of the gallbladders			Total
	Above the inferior border of liver	Below the inferior border of liver	At the level of inferior border of liver	
Male (n=41)	11 (26.8 %)	20 (48.8 %)	10 (24.4 %)	41(100.0%)
Female(n=27)	4 (14.8 %)	14 (51.9 %)	9 (33.3 %)	27 (100.0%)
Total	**15 (22.1%)**	**34 (50.0 %)**	**19 (27.9%)**	**68 (100.0%)**

Table VI showed the relation between gender of the cadaveric respondents and extension of fundus of the gallbladders in respect of inferior border of liver (n=68). It reveals that proportion of extension of fundus of gallbladders above inferior border of livers were more among the male cadavers (26.8 %) than female cadavers (14.8 %). But extension of fundus of gallbladders at the level and below the level of inferior border of liver were proportionately high among female cadavers (51.9% & 33.3 % respectively) than male cadavers (48.8 % and 24.4 % respectively). A chi-square test for independence with $\alpha = .05$ was used to assess whether gender of the respondents related to extension of fundus of the gallbladders in respect to inferior border of liver. The relation between variables were statistically not significant ($\chi 2 = 1.56$, df= 2, $p>.05$).

Discussion

This cross-sectional descriptive study was conducted over a period of one year from January 2021 to December 2021 in the department of Anatomy, Rajshahi medical college, Rajshahi in collaboration with Forensic Medicine Department of both RMC,Rajshahi and Shaheed Tajuddin Ahmad Medical College, Gazipur. After fulfilling the inclusion criteria, data were collected purposively with the help of a structured questionnaire by observation of 68 cadaveric gallbladders for their morphological features as well as measuring some morphological parameters with the help of respective research instruments.

In this study among the cadavers, 3/5th (60%) of them were male and remaining 2/5th (40%) of them were female. In both age group males were proportionately more than female cadavers (62.2% vs 37.8% in 20 to 40 years old and 58.1% vs 41.9% in 41 to 65 years old age group). In this study the relation between age group of the cadaveric respondents and shape of gall bladders (n=68) reveals that both pear (20-40 years old vs 41-65 years old cadavers = 89.2% vs 83.9%) and cylindrical (20-40 years old vs 41-65 years old cadavers = 10.8% vs 9.7%) shape gallbladders were proportionately more among the 20-40 years old cadavers than 41-65 years old cadavers. But irregular shape gall bladders were proportionately higher among the 41-65 years old cadavers (6.5%) and none of the 20-40 years old cadavers (0.0 %) had irregular shape gallbladders. The relation between variables were statistically not significant ($\chi 2 = 3.22$, df= 2, p >.05).

Different morphological features of gall bladder in this study reveals that only few (2.9%) of the gallbladders had folding, present anteriorly at the level of fundus but maximum (97.1%) had no folding at this level. At the level of the neck of gall bladders, no folding present.

The folded fundus of the gall bladder, also called as the Phrygian cap, was reported in 3 – 7.5% of gall bladder by which was almost similar proportion to the present study[13]. Another study had observed the folding of gallbladders at neck and fundus level, out of 6 cases (12 %), 2 cases had folding at neck and in 4 cases had folding present at fundus (Phrygian cap)[14]. Interior of gall bladder was found to have large number of rugosities. Gall stone was found in 1 case only which was also not similar to the present study[15]. 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.

In the present study Hartman's pouch was absent in all (100%) and gallbladder fossa were present in all (100%) visceral surface of livers. Again about 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[16,17] 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 that study, they found folded fundus in 2 specimens (6.66%).

In this study extension of the fundus of gall bladder in relation to inferior border of liver reveals that about half (50%) of the fundus of the gall bladders were extended below inferior border of liver and just more than one 1/4th (27.9%) fundus were at the level of inferior border of liver. Again, more than 1/5th (22.1%) of the fundus of gall bladders were above the inferior border of liver. In a study About 1/3rd (33.33%) fundus of the gall bladders were found to be extending within the inferior boarder, 1/3rd (33.33 %) extended beyond the inferior boarder and 1/3rd (33.33 %) fundus of gallbladder extended up to the inferior boarder of liver which were quite dissimilar proportion of the present study[17].

The relation between age group of the cadaveric respondents and extension of fundus of the gall bladders in respect of inferior border of liver (n=68) reveals that proportion of extension of fundus of gall bladders above inferior border of livers were more among the 41-65 years old cadavers (29.0 %) than 20-40 years old cadavers (16.2%). But extension of fundus of gall bladders both at the level and below the level of inferior border of liver were proportionately high among 20-40 years old cadavers (54.1% & 29.7% respectively) than 41- 65 years old cadavers (45.2 % and 25.8 % respectively). The relation between variables were statistically not significant ($\chi 2 = 1.62$, df= 2, p >.05).In this study the relation between gender of the cadaveric respondents and extension of fundus of the gall bladders in respect of inferior border of liver (n=68) reveals that proportion of extension of fundus of gall bladders above inferior border of livers were more among the male cadavers (26.8 %) than female cadavers (14.8 %). But extension of fundus of gall bladders at the level and below the level of inferior border of liver were proportionately high among female

cadavers (51.9% & 33.3 % respectively) than male cadavers (48.8 % and 24.4 % respectively. The relation between variables were statistically not significant ($\chi 2$ = 1.56, df= 2, p >.05). So far, I explored there was a very few published scientific literatures founded to compare the variables of interest in respect of age and gender variables of the respondents like the present study.

Conclusion

The data derived from the study might be useful for the adding some knowledge regarding gallbladders morphological difference in relation to age and gender besides others establish points for students and researchers in general. The knowledge obtained from the study might be useful for the Anatomists, General Surgeons, Laparoscopic Surgeons and Gastroenterologists in particular to apply the knowledge derived from the studies in their professional practices. The present study will also provide valuable data for the determination morphological variations of gall bladder in the Bangladeshi population which would help forensic experts, anthropologists.

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