

Morphological Parameters of Gallbladder are Correlated with Age

Farjana Mansura*¹, Kazi Abdullah Al Mamun², Abdullah Al Faisal³, Mahmuda Khatun⁴, Halima Akter Suchi⁵

Abstract

Introduction: Gallbladder issues are prevalent globally, particularly in Bangladesh, and become more common with age. Diagnosis involves clinical assessment and confirmation through noninvasive and invasive methods. Understanding gallbladder features is crucial for effective investigation, diagnosis, and management. **Objectives:** To find out relation between morphological parameters of human gallbladder with age. **Materials and Methods:** This cross-sectional descriptive study was conducted in the Department of Anatomy in collaboration with the Department of Forensic Medicine, Sylhet MAG Osmani Medical College, Sylhet from January 2014 to December 2014. Fifty human postmortem gallbladders were selected. Dead bodies autopsied within 36 hours of death. Considerable signs of decomposition or decomposed dead body, presence of gross gallbladder disease and any history of poisoning cases were excluded. All the specimens were examined to detect the length, breadth, weight and thickness of the gallbladder; and length and diameter of cystic duct. **Results:** The study included cadavers ranging in age from 11 to 55 years, with a mean age of 35.02 ± 19.98 years. Of the total, 29 (58.0%) were male, and 21 (42.0%) were female. The length and thickness of the gallbladder increased significantly with age, as did the length and diameter of the cystic duct. But the weight and breadth also change with age, although not significantly. **Conclusion:** The length and thickness of the gallbladder; the length and diameter of the cystic duct were varied with age; but no variation in weight and breadth.

Keywords: Morphological parameters, gallbladder, age.

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Introduction:

The gallbladder is a flask-shaped, blind-ending diverticulum attached to the common bile duct by the cystic duct. In life, it is grey-blue in colour and usually lies attached to the inferior surface of the right lobe of the liver by connective tissue. In the adult the gallbladder is between 7 and 10 cm long. It usually lies in a shallow fossa in the liver parenchyma covered by peritoneum continued from the liver surface. This attachment can vary widely. At one extreme the gallbladder may be almost completely buried within the liver surface, having no peritoneal covering (intraparenchymal pattern); at the other extreme it may hang from a short mesentery formed by the two layers of peritoneum separated only by connective tissue and a few small vessels (mesenteric pattern)¹.

The gallbladder stores bile up to 5 fold of its capacity and concentrates bile by absorbing water to a maximum 20 fold. Bile is secreted by the liver cells but most of it is normally stored in the gallbladder until needed. The maximum volume that the gallbladder can hold is only 30 to 60 milliliters^{2,3}.

The organ is divided into fundus, body and neck, the latter opening into the cystic duct. In dilated and pathological gall-bladders there is frequently a pouch present on the ventral aspect just proximal to

the neck termed Hartmann's pouch in which gallstones may become lodged. The gall-bladder is supplied by the cystic artery (a branch usually of the right hepatic artery) which lies in the triangle made by the liver, the cystic duct and the common hepatic duct. Other vessels derived from the hepatic artery pass to the gall-bladder from its bed in the liver. Interestingly, small veins pass from the gall-bladder through its bed directly into tributaries of the right portal vein within the liver⁴.

The gall-bladder wall and the sphincter of Oddi contain muscle, but there are only scattered muscle fibres throughout the remaining biliary duct system. The mucosa is lined throughout by columnar cells and bears mucus-secreting glands⁴.

The gall-bladder and ducts are subject to numerous anatomical variations which are best understood by considering their embryological development. A diverticulum grows out from the ventral wall of the duodenum which differentiates into the hepatic ducts and the liver. Another diverticulum from the side of the hepatic duct bud forms the gall-bladder and cystic duct⁴.

Some variations in biliary anatomy are (a) Along cystic duct joining the hepatic duct low down behind the duodenum. (b) Absence of the cystic duct—the gall-bladder opens directly into the common hepatic duct. (c) A double gall-bladder, the result of a rare bifid embryonic diverticulum from the hepatic duct. (d) The right hepatic artery crosses in front of the common hepatic duct; this occurs in 25 per cent of cases⁴.

Liver and biliary diseases are the most common health problem throughout the world as well as in Bangladesh. The most common biliary diseases are cholelithiasis⁵. Gallstones afflict 10% to 20% of adult populations in developed countries. It is estimated that over 20,000,000 persons in the United States have gallstones (Crawford, 2005). Up to 25% of all Bangladeshi people have gallstones⁵. Cholecystitis is associated with cholelithiasis in 95% cases (Crawford, 2005)⁶. Gallstone formation is the most common disorder of the biliary tree and it is unusual for the gallbladder to be diseased in the absence of gall stone⁷. The commonest lesion observed is chronic cholecystitis (80%) followed by acute cholecystitis (9.3%) invasive carcinoma (7.3%) carcinoma in situ (0.6%) and dysplasia (0.6%)⁸.

A traditional cholecystectomy is most commonly performed from the infundibulum to the fundus as no medical treatment is still available. Now a day's laparoscopic cholecystectomy replaces the open surgical method⁵. During operation surgeons have to identify the cystic duct and cystic artery properly before ligation. Uncontrolled bleeding from the cystic artery and its branches is a serious problem that may, increase the risk of intraoperative lesions to vital vascular and biliary structures⁵. The performance of a safe cholecystectomy depends on thorough knowledge about the normal

anatomy and anatomical variations that may contribute to the occurrence of major postoperative complications.

Materials and Methods:

This cross-sectional descriptive study was conducted in the Department of Forensic Medicine in Sylhet M.A.G Osmani Medical College from 1st January 2014 to 31st December 2014 over a period of one year. Fifty dead bodies autopsied within 36 hours of death were included in this study. Bodies with considerable signs of decomposition, any gross gallbladder disease, any injury to the gallbladder or biliary tract area and any history of poisoning were excluded from this study. Data were collected by using pre-designed checklist prepared for the study. The questionnaires were pre-tested and face validated by consulting with experts.

A total 50 human gallbladder were collected from 50 cadavers, whose age limits were from 11-55 years, of both sexes. The specimens were divided into three groups by age according to Khan et al.⁹ for the convenience of differentiating the changes if various histomorphological features of the gallbladder in relation to age. Group A consisted with 7 patients of age 11-20 years, Group B with 28 patients of age 21-40 years and Group C with 15 patients of age 41-55 year.

Fifty human gallbladders were collected from the unclaimed dead bodies autopsied in the Department of Forensic Medicine in Sylhet M.A.G Osmani Medical College, Sylhet during the period from January 2014 to December 2014 meeting the inclusion and exclusion criteria. Particulars of dead body was collected from police inquest report and chalan.

Dead body was kept in supine position on the mortuary table. A longitudinal midline incision was made from the tip of the xiphoid process to the upper border of the symphysis pubis encircling the umbilicus. Then a transverse incision was made from the xiphoid process to mid axillary line in both side. Another incision was made from the symphysis pubis to the anterior superior iliac spine along with inguinal line both side. Then skin and superficial fascia was retracted laterally. After cutting the rectus sheath and parietal peritoneum abdomen was opened. Then gallbladder was identified. Then gallbladder along with cystic duct was collected as block dissection with part of the liver and part of common hepatic duct. After removal from the body, unwanted tissues were cleared and gently washed out in normal saline and fixed with 10% formol saline. Then they were brought to the Department of Anatomy, Sylhet M.A.G Osmani Medical College, Sylhet.

Measurement of the parameters of gallbladder and cystic duct

Bile was removed by cutting one edge of the gallbladder. The interior of the gallbladder was washed and cleaned thoroughly and carefully. The surface of the gallbladder was dried with blotting paper. Then it was weighed by means of an analytical balance (Mega digital scale, made

in china) expressed in grams. Length of the gallbladder was measured from the neck of the gallbladder to the maximum convexity of the fundus using a thread and imposed it on a measuring scale expressed in centimeter. The breadth was measured at its maximum width in the body of the gallbladder using a thread and imposed it on a measuring scale expressed in centimeter. As the gallbladder was irregular in its shape, therefore, three readings were taken for each parameter and the average value was taken and recorded. After cutting from one edge the inner wall of the gallbladder was exposed and washed and cleaned thoroughly and carefully, then the thickness of the gallbladder i.e. wall thickness was measured at three points by using slide calipers expressed in millimeter and the average value was taken and recorded. The length of the cystic duct was measured from neck of the gallbladder to the junction of its to common hepatic duct by using a thread and imposed it on a measuring scale and the value was expressed in centimeter. The diameter of the cystic duct was measured by using a slide calipers and the value was expressed in millimeter.

Data were processed manually and analyzed with the help of SPSS (Statistical package for social sciences) Version 21.0. Quantitative data were expressed as mean and standard deviation; and comparison was done by unpaired t test between two groups and ANOVA test among three groups. A probability value (p) of less than 0.05 was considered statistical significant.

Prior to the commencement of the study, approval of the research protocol was obtained from the Ethical Committee of Sylhet M.A.G Osmani medical college, Sylhet.

Observations and Results

A total of 50 human postmortem gallbladders were studied in the present work. All the specimens were examined to detect the morphology of gallbladder, but only 18 specimens examined histologically. The outcome of the study was as follows:

Distribution of age of the cadaver

The age of the cadaver ranged from 11 to 55 years with the mean age of 35.02 (SD \pm 19.98) years. Distribution of the cadaver by age group was shown in figure 1.

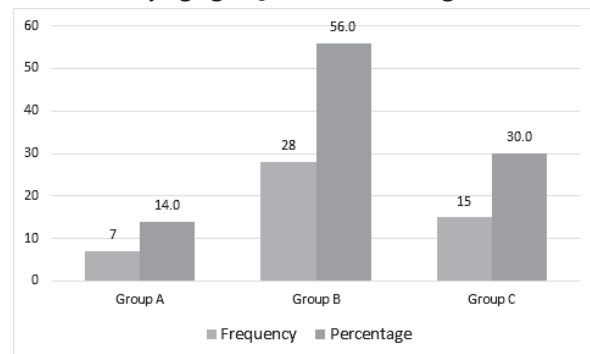


Figure-1: Distribution of the cadaver by age group (n=50)

In this study age Group-A (11-20 years) constituted 7 (14.0%) cases, age Group-B (21-40 years) constituted 28 (56.0%) cases and age Group-C (41-55 years) constituted 15 (30.0%) cases.

Distribution of the cadaver by sex

There were 29 (58.0%) male and 21 (42.0%) female with a ratio of male to female was 1.38:1. Distribution of the cadaver by sex was shown in figure 2.

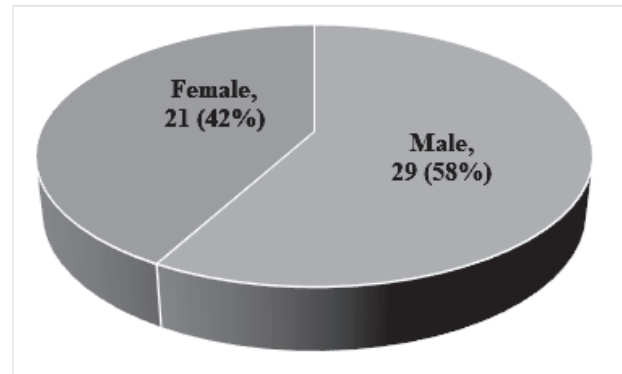


Figure-2: Distribution of the cadaver by sex (n=50)

Distribution of the parameters of gallbladder by different age group

The mean length of the gallbladder was 7.07 \pm 0.55 cm in the age group of 11 to 20 years; 8.00 \pm 0.88 cm in the age group of 21 to 40 years and 8.57 \pm 1.05 cm in the age group of 41 to 55 years. The difference among the groups was statistically significant (F=6.622; p=0.003).

The mean weight of the gallbladder was 4.58 \pm 1.39 gm in the age group of 11 to 20 years; 6.26 \pm 2.12 gm in the age group of 21 to 40 years and 6.98 \pm 2.51 gm in the age group of 41 to 55 years. The difference among the groups was statistically not significant (F=2.920; p=0.064).

The mean breadth of the gallbladder was 2.90 \pm 0.45 cm in the age group of 11 to 20 years; 3.07 \pm 0.43 cm in the age group of 21 to 40 years and 3.19 \pm 0.44 cm in the age group of 41 to 55 years. The difference among the groups was statistically not significant (F=1.112; p=0.338).

The mean thickness of the gallbladder wall was 1.33 \pm 0.16 mm in the age group of 11 to 20 years; 1.61 \pm 0.14 mm in the age group of 21 to 40 years and 2.25 \pm 0.35 mm in the age group of 41 to 55 years. The difference among the groups was statistically significant (F=52.845; p=0.0001).

Table I: Distribution of the parameters of cystic duct by different age group

Parameters of gallbladder	Total	Group-A (n=7)	Group-B (n=28)	Group-C (n=15)	p-value
Length (cm)	8.04 \pm 1.00 (6.5-10.5)	7.07 \pm 0.55 (6.5-8.0)	8.00 \pm 0.88 (7.0-10.0)	8.57 \pm 1.05 (7.0-10.5)	0.003
Weight (gm)	6.24 \pm 2.25 (2.0-9.88)	4.58 \pm 1.39 (2.80-6.76)	6.26 \pm 2.12 (2.40-9.23)	6.98 \pm 2.51 (2.00-9.88)	0.064
Breadth (cm)	3.08 \pm 0.48 (2.5-4.0)	2.90 \pm 0.45 (2.50-3.50)	3.07 \pm 0.43 (2.50-4.00)	3.19 \pm 0.44 (2.50-3.80)	0.338

Parameters of gallbladder	Total	Group-A (n=7)	Group-B (n=28)	Group-C (n=15)	p-value
Thickness of wall (mm)	1.76±0.40 (1.1-2.9)	1.33±0.16 (1.10-1.60)	1.61±0.15 (1.40-1.90)	2.25±0.35 (1.70-2.90)	0.0001

ANOVA test was done

Distribution of the parameters of cystic duct by different age group

The mean length of the cystic duct was 2.57 ± 0.31 cm in the age group of 11 to 20 years, 2.74 ± 0.21 cm in the age group of 21 to 40 years and 3.02 ± 0.22 cm in the age group of 41 to 55 years. The difference among the groups was statistically significant (F=11.178; p=0.001).

The mean diameter of the cystic duct was 2.54 ± 0.17 mm in the age group of 11 to 20 years; 3.12 ± 0.45 mm in the age group of 21 to 40 years and 3.22 ± 0.27 mm in the age group of 41 to 55 years. The difference among the groups was statistically significant (F=8.277; p=0.001).

Table II: Distribution of the parameters of cystic duct by different age group

Parameters of gallbladder	Total	Group-A (n=7)	Group-B (n=28)	Group-C (n=15)	p-value
Length (cm)	2.80±0.27 (2.0-3.5)	2.57±0.31 (2.00-2.90)	2.74±0.21 (2.30-3.20)	3.02±0.22 (2.70-3.50)	0.0001
Diameter (mm)	3.07±0.43 (2.1-3.8)	2.54±0.17 (2.30-2.80)	3.12±0.45 (2.10-3.80)	3.22±0.27 (2.80-3.60)	0.001

Discussion:

In this study the age of the cadaver ranged from 11 to 55 years with the mean age of (35.02 ± 19.98) years. In this regards Rahman and Anwar⁵ found that age of the cadaver ranged from 20 to 65 years. Difference was may be due to inclusion of younger age in the present study.

This study also showed that age Group-A (11-20 years) constituted 7 (14.0%) cases, age Group-B (21-40 years) constituted 28 (56.0%) cases and age Group-C (41-55 years) constituted 15 (30.0%) cases. Similar findings were observed in the study of Nahar et al¹⁰. In the current study there were 29 (58.0%) male and 21 (42.0%) female with a ratio of male to female was 1.38:1. Nahar¹¹ also included similar sex distribution of cadavers that 39 (55.7%) male and 31 (44.3%) female cadaver with a ratio of male to female was 1.26:1 in her study.

In this study the length of the gallbladder ranged from 6.5 to 10.5 cm with the mean 8.04 ± 1.00 cm. This result was correlated with several other studies^{12,13,14}. All these studies, the length of the gall bladder was 7 to 10 cm. Rahman et al.¹⁵ found that the average length of the gall bladder was 6-7cm. In this study the mean length of the gallbladder was 7.07 ± 0.55 cm in the age group of 11 to 20 years; 8.00 ± 0.88 cm in the age group of 21 to 40 years and 8.57 ± 1.05 cm in the age group of 41 to 55 years. The difference among the groups was statistically significant (p=0.003). Nahar¹¹, found that the mean length of the gallbladder

in male and female between group A and B (p<0.05) and group A and (p<0.01) were statistically significant.

In the present study the weight of the gallbladder ranged from 2.0 to 9.88 gm with the mean 6.24 ± 2.25 gm. This result was consistent with the study of Nahar¹¹ where the mean weight of the gallbladder was 6.37± 0.29 gm in male and 6.26 ± 0.03 gm in female in the age group of 10-20 years. The mean weight of the gallbladder was 4.58 ± 1.39 gm in the age group of 11 to 20 years; 6.26 ± 2.12 gm in the age group of 21 to 40 years and 6.98 ± 2.51 gm in the age group of 41 to 55 years. The difference among the groups was statistically not significant (p=0.064). This result was correlated with the study of Nahar¹¹, that the mean weight of the gallbladder in male and female among the groups was statistically not significant (p>0.05).

In the current study the breadth of the gallbladder ranged from 2.50 to 4.00 cm with the mean 3.08 ± 0.48 cm. Rahman et al.¹⁵ found that the average breadth of the gall bladder was 2cm. Vakili and Pomfret¹⁶ reported that the breadth of the gall bladder was 4 cm. Turner et al.¹¹ reported that the breadth of the gall bladder was 3-5 cm. Chari and Shah¹³ found that the breadth of the gall bladder was 2-5 cm. In the present study the mean breadth of the gallbladder was 2.90 ± 0.45 cm in the age group of 11 to 20 years; 3.07 ± 0.43 cm in the age group of 21 to 40 years and 3.19 ± 0.44 cm in the age group of 41 to 55 years. The difference among the groups was statistically not significant (p=0.338). This result was supported by Nahar¹¹, that the mean breadth of the gallbladder of male and female was not statistically significant in any age group (p>0.50).

This study showed that the thickness of the gallbladder wall ranged from 1.10 to 2.90 mm with the mean 1.76 ± 0.40 mm. Majeski¹⁷, found that the thickness of the adult gallbladder wall was 3mm. This finding is slightly higher than the present study. This variation is probably due to difference in geographical distribution and racial variation. In the current study the mean thickness of the gallbladder wall was 1.33 ± 0.16 mm in the age group of 11 to 20 years; 1.61 ± 0.14 mm in the age group of 21 to 40 years and 2.25 ± 0.35 mm in the age group of 41 to 55 years. The difference among the groups was statistically significant (p<0.001). Nahar¹¹, found that the difference in mean thickness of the gallbladder wall in male between group A and C (p<0.01) and group B and C (p<0.05) were statistically significant which correlated with the present study. Khan et al., (2012) found that the thickness of the gallbladder wall was 1.47±0.06 mm in group A (10-20 years), 1.57 ± 0.05 mm in group B (21-40 years) and 1.61 ± 0.04 mm in group C (41-70 years).

In this study the length of the cystic duct ranged from 2.00 to 3.50 cm with the mean 2.80 ± 0.27 cm. In this regards Stranding¹, found the length of the cystic duct was 3-4 cm. Limthanakhom et al.¹⁸ found that the mean length of the cystic duct was 1.42 cm. According to Sinnatamby¹⁹, the length of the cystic duct is 2-3 cm and according to Moore et al. ¹⁴, the length of the cystic duct is 3-4 cm. In this study the mean length of the cystic duct was 2.57 ± 0.31 cm in the age group of 11 to 20

years; 2.74 ± 0.21 cm in the age group of 21 to 40 years and 3.02 ± 0.22 cm in the age group of 41 to 55 years. The difference among the groups was statistically significant ($p=0.001$). In this regards Nahar et al.¹⁰ found that the mean length of the cystic duct between male and female was not statistically significant in any age group ($p > 0.50$).

The diameter of the cystic duct ranged from 2.10 to 3.80 mm with the mean 3.07 ± 0.43 mm. This result was correlated with the study of Sinnatamby¹⁹, where the diameter of the cystic duct was 2-3 mm. Nahar¹¹ found that the mean diameter of the cystic duct in male and female were 2.07 ± 0.56 mm and 2.20 ± 0.64 mm respectively in group B (21-40 year); and 2.73 ± 0.59 mm and 2.95 ± 0.60 mm respectively in group C (41-55 year). In the present study the mean diameter of the cystic duct was 2.54 ± 0.17 mm in the age group of 11 to 20 years; 3.12 ± 0.45 mm in the age group of 21 to 40 years and 3.22 ± 0.27 mm in the age group of 41 to 55 years. The difference among the groups was statistically significant ($p=0.001$). The difference in mean diameter of the cystic duct in male and female was statistically significant in between group A and C and group B and C ($p < 0.01$) reported in the study of Nahar et al.¹⁰.

Conclusion:

The length and thickness of the gallbladder, the length and diameter of the cystic duct were varied with age; but no variation in weight and breadth.

Conflict of Interests: None.

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References:

1. Standring S, Gray's Anatomy. Spain: Churchill Livingstone. Elsevier. 2008;208:1179-80.
2. Guyton AC, Hall JE. Textbook of Medical Physiology. 11th ed. China: Elsevier Saunders. 2006; 799-802.
3. Snell RS. Clinical Anatomy by Region. 8th ed, USA, Williams and Wilkins Company. 2008; 256-258.
4. Ellis H. Clinical Anatomy: A Revision and Applied Anatomy for Clinical Students. 11th ed. India: Blackwell Publishing Ltd. 2006; 93-101.
5. Rahman MK, Anwar S. Presence of Cystic Artery in the Calot's Triangle and Its Relation with Common Hepatic Duct a Postmortem Study. Bangladesh Journal of Anatomy. 2012;10(2):50-6.
<https://doi.org/10.3329/bja.v10i2.17282>
6. Crawford JM. Liver and biliary tract. In: Kumar V, Abbas AK,

7. Fausto N, editors. Robbins and Cotran Pathologic Basis of Disease. 7th ed. China: Elsevier Saunders; 2005: p.928.
8. Collier JD, Webster G. Liver and Biliary Tract Disease. In: Colledge NR, Walker BR, Ralston SH, editors. Davidson's Principles and Practice of Medicine. 21st ed. Edinburgh: Churchill Livingstone. 2009; 156-190.
9. Nadeem I, Nagin H. Morphological profile of gallbladder disease. J Rawal Med Coll. 2004; 4(1-2): 30-33.
10. Khan LF, Naushaba H, Paul UK, Banik S, Al-Safri MA. Gross and histomorphological study of thickness of the gallbladder wall. Journal of Dhaka National Medical College & Hospital. 2012 Oct 19;18(1):34-8.
<https://doi.org/10.3329/jdnmch.v18i1.12238>
11. Nahar N, Ara S, Rahman M, Afroz H. Length and diameter of the cystic duct: a postmortem study. Bangladesh Journal of Anatomy. 2011;9(2):89-92.
<https://doi.org/10.3329/bja.v9i2.15278>
12. Nahar N. Gross and histomorphological study of the gallbladder in Bangladeshi people [M Phil, Thesis]. Bangabondhu Sheikh Mujib Medical University, Dhaka. 2009.
13. Turner MA, Fulcher AS. Gore RM, Levine MS, Editors. Textbook of Gastrointestinal Radiology. 2nd ed. Vol. 2. Philadelphia: WB Saunders. 2000; 1250-1276.
14. Chari RS, Shah SA. Sabiston Textbook of Surgery. 18th ed. St. Louis: WB Saunders. 2008; 1474-1514.
15. Moore KL, Dalley II AF, Agur AMR. Clinically Oriented Anatomy. 6th ed, Philadelphia, Lippincott Williams & Wilkins. 2010; 242-250.
16. Rahman K, Akhter AB, Anwar S, Begum AA, Ahmed S, Saha NC. Study of the Morphological Characteristics of the Human Gallbladder in Relation to Age and Sex of Bangladeshi People. Bangladesh Journal of Anatomy. 2013;11(2):81-5.
<https://doi.org/10.3329/bja.v11i2.20676>
17. Vakili K, Pomfret EA. Biliary anatomy and embryology. Surgical Clinics of North America. 2008 Dec 1;88(6):1159-74.
<https://doi.org/10.1016/j.suc.2008.07.001>
PMid:18992589
18. Majeski J. Significance of preoperative ultrasound measurement of gallbladder wall thickness. The American surgeon. 2007 Sep;73(9):926-9.
<https://doi.org/10.1177/000313480707300922>
PMid:17939429
19. Limthanakhom T, Khamanarong K, Bhudhisawasdi V. The Anatomical Variations of Cystic Duct in Northeastern Thai Population. The Thai Journal of Surgery. 2005 Sep 30;26(3):73-7.
20. Sinntamby CS. Last's Anatomy Regional and Applied. 10th ed. Edinburgh: Churchill Livingstone. 1999; 257 -259.