

PROFILE OF BILE DUCT STONES PATIENTS UNDERGOING ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY (ERCP) IN WAHIDIN SUDIROHUSODO GENERAL HOSPITAL MAKASSAR

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Keywords:

Bile Duct Stones, Gender, Age, Diabetes Mellitus, Hyperlipidemia, Liver Function Test

ABSTRACT

Gallstone diseases (especially choledocholithiasis) are a significant health issue because they have high incidence due to changes in lifestyle, diet pattern, and sedentary lifestyle, increasing health costs. The prevalence of choledocholithiasis comprises 12% of the adult population in the US. Aside from lifestyle changes, choledocholithiasis is also affected by other factors such as age, gender, genetics, factors related to metabolic syndrome, diet, and medicines consumed. The liver function test is the biochemical test of choice for gallstones and bile duct stones patients where increased ALP enzyme level with GGT can help in establishing the diagnosis of blockage of the bile duct. Therefore, this study is conducted to determine the profile of bile duct stone patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital, Makassar. This is an observational descriptive study with a retrospective cohort approach using a purposive sampling method on bile duct stones patients who underwent ERCP. The results revealed that bile duct stones are mostly found in men (61%), 45-59 years old (40.6%), non-obesity (76.3%), prediabetes (42.4%), non-hyperlipidemia (89%), increased level of AST/SGOT (72%), ALT/SGPT (77%), GGT (76.2%), total bilirubin (81.4%), and direct bilirubin (75.4%). Thus, it concludes that the profile of choledocholithiasis patients in Dr. Wahidin Sudirohusodo General Hospital Makassar in November 2021-November 2022 are mostly men, aged 45-59 years old, without obesity, have prediabetic status, hyperlipidemia, and increased level of AST/SGOT, ALT/SGPT, GGT, total bilirubin, and direct bilirubin.



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1. Introduction

Gallstone diseases (especially choledocholithiasis) are still a significant health problem [1], [2]. The prevalence of this disease increases due to changes in lifestyle, diet patterns, and sedentary lifestyles [3], [4]. Choledocholithiasis is characterized by stones or sludges in the common bile duct (CBD) and/or common hepatic duct (CHD), which is often derived from the gallbladder [5]. Choledocholithiasis is caused by cholestasis (dysfunction of the sphincter of Oddi, benign biliary stricture, cholangitis sclerosis, bile duct cyst, and parasite infection), and chronic biliary infection [6], [7]. The prevalence of choledocholithiasis comprises 12% of the adult population in the US. Choledocholithiasis is affected by several factors, including age, gender, genetics, factors related to metabolic syndrome, diet, and medicines consumed [1].

Liver function tests (ALT, AST, bilirubin, ALP, and GGT) are the biochemical tests of choice in gallstones and bile duct stones patients. Increased ALP enzyme levels with GGT can help establish the diagnosis of blockage in the bile duct [8]. Patients with choledocholithiasis who did not seek treatment immediately can experience acute suppurative cholangitis, pancreatitis, biliary cirrhosis, and biliary perforation. One of the treatments of choledocholithiasis is endoscopic cholangiopancreatography (ERCP) with a success rate of up to 98% [1], [6].

2. RESEARCH OBJECTIVES

This studies aim to determine the profile of bile duct stones patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar from November 2021-November 2022.

3. METHOD AND RESEARCH SUBJECT

3.1 Research Method

This is an observational descriptive study that uses a retrospective cohort approach in the Gastro Centre of Dr. Wahidin Sudirohusodo General Hospital Makassar from November 2021 to November 2022 using the purposive sampling method. The population is patients diagnosed with bile duct stones established from abdominal ultrasound and abdominal CT scan. The inclusion criteria included bile duct stone patients who underwent endoscopic retrograde cholangiopancreatography (ERCP) with complete medical record data. Data were grouped based on gender, age, metabolic status, and liver function test.

3.2 Statistical Analysis

Data analysis was conducted with a descriptive quantitative approach. Afterward, the data were presented in percentages, while analyses were presented in descriptive tables and explanations. Data were analyzed using the Statistical Product and Service Solution (SPSS) software for Windows version 26.0.

4. RESULTS

4.1 Subject Characteristics

This study involved 129 subjects who underwent ERCP and fulfilled the study criteria which included 19-83 years of age with a mean of 49.8 ± 13.1 years old. The level of AST/SGOT of the subjects varied between 12-345 U/l with a mean of 81.64 ± 70.31 , and ALT/SGPT varied between 7-997 U/l with a mean of 110.59 ± 130.44 . The total bilirubin level of the subjects varied between 0.28-65.78 mg/dl with a mean of 10.0 ± 10.96 . The direct bilirubin level of the subjects varied between 0.09-39.40 mg/dl with a mean of 7.11 ± 7.95 .

Table 1 Sample Characteristics

Descriptive Statistics of the Study Variables (n=129)

Variable	Unit	Minimum	Maximum	Mean	SD
Age	Year	19	83	49.75	13.05
GDP	mg/dl	78	379	128.19	48.28
AST/SGOT	U/l	12	345	81.64	70.31
ALT/SGPT	U/l	7	997	110.59	130.44
Total bilirubin	mg/dl	0.28	65.78	10.00	10.96
Direct bilirubin	mg/dl	0.09	39.40	7.11	7.95

The distribution of categories related to the studied variables had the following subject characteristics: The majority of bile duct stones occurred in 72 men (61%) and 46 women (39%). The highest frequency of bile duct stones occurred in 48 people aged 45-59 years old (40.6%). In the aspect of body mass index (BMI), which described the obesity condition of the subjects, most cases occurred in non-obese patients, consisting of 90 people (76.3%).

History of comorbidities (type 2 DM and hyperlipidemia) found 42 people (35.6%) with a history of type 2 diabetes mellitus, mostly found in subjects with impaired fasting glucose (IFG), comprising 50 people (42.4%). As for lipid status, the majority of subjects (105 people; 89%) had no hyperlipidemia. Liver function tests revealed an increase in SGOT and SGPT in 85 people (72%) and 91 people (77%), respectively. There was also an increase of GGT and ALP in 90 people (76.3%) and 47 people (40%), respectively, and an increase of total and direct bilirubin in 96 people (81.4%) and 89 people (75.4%), respectively.

Table 2 Subject characteristics

Variable	n	%
Gender		
Men	72	61
Women	46	39
Age		
19-44 years	38	32.2
45-59 years	48	40.6
>= 60 years	32	27.2
Body Mass Index (BMI)		
Obese	28	23.7
Non-obese	90	76.3
DM Type 2		
DM	42	35.6
IFG	50	42.4
Non-DM	26	22
Hyperlipidemia		
Yes	13	11
No	105	89
SGOT/AST		
Increased	85	72
Normal	33	28
SGPT/ALT		
Increased	91	77
Normal	27	23
Glutamyl Transferase/Gamma-GT		

Increased	90	76.3
Normal	28	23.7
Alkali Phosphatase/ALP		
Increased	47	40
Normal	71	60
Total Bilirubin		
Increased	96	81.4
Normal	22	18.6
Direct Bilirubin		
Increased	89	75.4
Normal	29	24.6
Stone		
Gallstone	11	8.5
Bile duct stone	118	91.5

Based on incidence, bile duct stones were found in 118 people (91.5%), while gallstones were found in 11 people (8.5%).

4.2 Demographic Factor of Bile Duct Stone

The number of choledocholithiasis cases with ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar included 72 men (61%) and 46 women (39%). This showed that choledocholithiasis occurred more in men than women with a ratio of 1.5:1.

Table 3 Distribution of choledocholithiasis cases based on gender in Dr. Wahidin Sudirohusodo General hospital Makassar in November 2021-November 2022

Gender	Cases (n)	Percentage (%)
Men	72	61
Women	46	39
Total	118	100

Choledocholithiasis patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar were mostly between 45-59 years old, comprising 48 people (40.6%), followed by 19-44 years old, comprising 38 people (32.2%), and ≥ 60 years old, comprising 32 people (27.2%).

Table 4 Distribution of choledocholithiasis cases based on age in Dr. Wahidin Sudirohusodo General Hospital Makassar in November 2021-November 2022

Age	Cases (n)	Percentage (%)
19-44 years	38	32.2
45-59 years	48	40.6
≥ 60 years	32	27.2
Total	118	100

4.3 Metabolic Status of Bile Duct Stones Patients

Choledocholithiasis patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar were mostly non-obese, with 90 people (76.3%), compared to obese patients with 28 people (23.7%).

Table 5 Distribution of choledocholithiasis cases based on body mass index (BMI) in Dr. Wahidin

Sudirohusodo General Hospital Makassar in November 2021-November 2022

BMI	Cases (n)	Percentage (%)
Obese	28	23.7
Non-Obese	90	76.3
Total	118	100

Choledocholithiasis patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar mostly had impaired fasting glucose (IFG), comprising 50 people (42.4%) compared to DM with 42 people (35.6%) and non-DM with 26 people (22%).

Table 6 Distribution of choledocholithiasis cases based on diabetes mellitus status in Dr. Wahidin Sudirohusodo General Hospital Makassar in November 2021-November 2022

DM	Cases (n)	Percentage (%)
DM	42	35.6
Impaired fasting glucose (IFG)	50	42.4
Non-DM	26	22
Total	118	100

Choledocholithiasis patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar mostly had no hyperlipidemia, comprising 105 people (89%) compared to hyperlipidemia with 13 people (11%).

Table 7 Distribution of choledocholithiasis cases based on hyperlipidemia condition in Dr. Wahidin Sudirohusodo General Hospital Makassar in November 2021-November 2022

Hyperlipidemia	Cases (n)	Percentage (%)
Yes	13	11
No	105	89
Total	118	100

4.4 Liver Function Test of Bile Duct Stones

Choledocholithiasis patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar mostly had increased AST/SGOT, comprising 85 people (72%) compared to patients with normal AST/SGOT with 33 people (28%). Meanwhile, the group with increased ALT/SGPT comprised 91 people (77%) compared to normal ALT/SGPT with 27 people (23%).

Table 8 Distribution of choledocholithiasis cases based on AST/SGOT and ALT/SGPT levels in Dr. Wahidin Sudirohusodo General Hospital Makassar in November 2021-November 2022

Result	AST/SGOT	Percentage	ALT/SGPT	Percentage (%)
	Cases(n)	(%)	Cases (n)	
Increased	85	72	91	77
Normal	33	28	27	23
Total	118	100	118	100

Choledocholithiasis patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar mostly had increased GGT levels, comprising 90 people (76.3%) compared to normal GGT with

28 people (23.7%).

Table 9 Distribution of choledocholithiasis cases based on GGT level in Dr. Wahidin Sudirohusodo General Hospital Makassar in November 2021-November 2022

Gamma- Glutamyl Transferase (GGT)	Cases (n)	Percentage (%)
Increased	90	76.3
Normal	28	23.7
Total	118	100

Choledocholithiasis patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar mostly had normal ALP with 71 people (60%), while there were 47 people (40%) with increased ALP.

Table 10 Distribution of choledocholithiasis cases based on ALP level in Dr. Wahidin Sudirohusodo General Hospital Makassar in November 2021-November 2022

Alkali Phosphatase (ALP)	Cases (n)	Percentage (%)
Increased	47	40
Normal	71	60
Total	118	100

Choledocholithiasis patients who underwent ERCP in Dr. Wahidin Sudirohusodo General Hospital Makassar mostly had increased total bilirubin levels in 96 people (81.4%) compared to people with normal total bilirubin levels in 22 people (18.6%). Meanwhile, there were 89 people (75.4%) with increased direct bilirubin levels compared to 29 people (24.6%) with normal direct bilirubin levels.

Table 11 Distribution of choledocholithiasis cases based on total and direct bilirubin levels in Dr. Wahidin Sudirohusodo General Hospital Makassar in November 2021-November 2022

Result	Total Bilirubin		Direct Bilirubin	
	Cases (n)	Percentage (%)	Cases (n)	Percentage (%)
Increased	96	81.4	89	75.4
Normal	22	18.6	29	24.6
Total	118	100	100	100

5. DISCUSSION

5.1 Profile of Bile Duct Stone Patients based on Gender

This study analyzed 118 patients (91.5%) with choledocholithiasis, comprising 72 men (61%) and 46 women (39%). This showed that choledocholithiasis is found more in men. This contradicts the previous study which showed that cholelithiasis is mostly found in women (67.71%) compared to men (32.29%). Other than that, [6], [9] also showed that bile duct stones are mostly found in women (72.72% and 76.27%, respectively) compared to men (27.28% and 23.72%, respectively) [10] also stated that gender is significantly related to the incidence of bile duct stones ($p < 0.001$).

Fertile women are 4 times more at risk of experiencing gallstones and bile duct stones than men, but the risk

decreases after entering menopause. This risk is related to estrogen, progesterone, pregnancy, and oral contraceptives. The hormone estrogen decreases the secretion of bile salts and increases the secretion of cholesterol into the gallbladder so that it can trigger the formation of saturated cholesterol. In addition, the hormone progesterone itself acts synergistically by causing gallbladder hypomotility, which can lead to bile stasis [6], [11], [12].

5.2 Profile of Bile Duct Stone Patients based on Age

This study indicated that bile duct stones mostly occurred in patients aged between 45-59 years old, followed by 19-44 years old. This indicated that bile duct stone incidence increased with age. This result is in line with a previous study which stated that the majority of cholelithiasis occurred at 40 years old, with 40-69 years old having more risk than younger age. This is because in old age there is a decrease in the activity of 7- α hydroxylase which is the rate-limiting enzyme for cholesterol biosynthesis [12], [13].

This study also supports [9] who showed that the incidence of bile duct stones mostly occurred at 45-64 years old. [6] stated that the average age of bile duct stone patients was 55 years old. Meanwhile, [14], [15] also stated that the average age of bile duct stone patients was 66.8 and 49.7 years old, respectively.

5.3 Profile of Bile Duct Stone Patients based on Body Mass Index (BMI)

This study showed that most bile duct stone cases were found in non-obese patients with 90 people (76.3%) compared to obese patients with 28 people (23.7%). This result is different from [2], [9] who stated that the majority of bile duct stones (72.72% and 47%, respectively) occurred in obese/overweight patients with a BMI of 23.1-27.5. Nevertheless, [10] stated that there is a statistically significant correlation between obesity and the incidence of bile duct stones ($p < 0.001$).

Obesity is associated with the occurrence of insulin resistance. Obesity can also increase the occurrence of a state of bile stasis and cholesterol saturation. Individuals with excessive BMI tend to consume foods that are high in calories which can disrupt the process of emptying the gallbladder. This causes gallbladder motility disorders so which can trigger sedimentation. In addition, individuals with excess BMI tend to have high cholesterol levels so they are at risk for developing gallstones as a result of increased activity of co-enzyme A-2 hydroxy-3 methylglutaryl (HMGCoA) reductase [16].

5.4 Profile of Bile Duct Stone Patients based on Diabetes Mellitus Status

This study showed that bile duct stones were found in 42 people (35.6%) with diabetes mellitus type 2 and 50 people (42.4%) with impaired fasting glucose (IFG). This study is supported by [17] found that 13.8% of patients diagnosed with gallstones through abdominal ultrasound had a history of type 2 diabetes mellitus, where diabetes mellitus can increase cholesterol saturation in the gallbladder. [2], [9], [14] also found that bile duct stones often occurred in patients with diabetes mellitus type 2 (3%, 8%, and 38.75%, respectively). The previous theory has been proven by [18], [19] that there is a statistically significant correlation between diabetes mellitus type 2 and bile duct stones ($p < 0.001$).

5.5 Profile of Bile Duct Stone Patients based on Lipid Condition

This study showed that bile duct stones are often found in patients without hyperlipidemia, comprising 105 people (89%) compared to patients with hyperlipidemia, comprising 13 people (11%). The results of this study were in line with [9] who found that bile duct stones are found more in patients without hyperlipidemia (84.1%) compared to hyperlipidemia (15.9%). [2] found that 17.6% of bile duct stone patients had increased total cholesterol, 7.35% had increased HDL, 9.31% had increased LDL, and 5.39% increased triglycerides from ERCP examination that showed bile duct stones.

One of the three major pathways in gallstone formation is cholesterol supersaturation. Usually, bile can dissolve the amount of cholesterol excreted by the liver. But if the liver produces more cholesterol than the bile can dissolve, this excess cholesterol can precipitate as crystals. The crystals are then trapped in the mucus in the gallbladder which will then produce gallbladder sludge. Over time, crystals can grow to form stones and block the ducts which eventually leads to bile duct stones [20]. A previous theory has been proven by [10] who showed that there is a statistically significant increase in cholesterol levels in bile duct stone incidence with $p < 0.001$.

5.6 Profile of Bile Duct Stone Patients based on AST/SGOT and ALT/SGPT Levels

This study showed that bile duct stones are found mostly in patients with increased AST/SGOT and ALT/SGPT with 85 people (72%) and 91 people (77%), while the rest of the group with normal AST/SGOT and ALT/SGPT comprised 27 people (23%). The results of this study were in line with [8], [9], [15] who revealed that bile duct stone patients often had increased levels of AST/SGOT (the percentages in each study were 30.3%, 67.5%, and 86.2%).

Some of the liver function tests are related to the occurrence of bile duct stones, one of which is AST/SGOT. AST/SGOT is an enzyme associated with liver parenchyma cells. AST/SGOT is not fully increased in every liver damage, but AST/SGOT can be detected also in damage involving heart muscle, skeletal muscle, and red blood cells. AST/SGOT has a low level of sensitivity and a high level of specificity in diagnosing gallstones, so it is indicated for examination in patients with suspected gallstones [8]. A previous theory has been proven by [14] who found that there is a statistically significant correlation between increased AST/SGOT levels on the incidence of bile duct stones ($p < 0.05$) [14].

5.7 Profile of Bile Duct Stone Patients based on Gamma-Glutamyl Transferase (GGT) Levels

This study showed that bile duct stones are found mostly in patients with increased GGT levels with 90 people (76.3%) compared to patients with normal GGT with 28 people (23.7%). The results of this study were in line with [8], [15], [21] who stated that bile duct stones are found mostly in patients with increased GGT levels (56.67%, 86.2%, and 85.71%, respectively).

GGT is an enzyme that converts gamma-glutamyl from glutathione in the glutathione cycle. GGT is present in several tissues such as the bile ducts, kidneys, and gallbladder, so it is considered an important marker of any cholestatic abnormalities found either intra- or extrahepatic. GGT has a high level of sensitivity and low specificity in diagnosing bile duct stones, so this GGT examination is indicated for every patient with suspected bile duct stones [8]. A previous theory has been proven by [14] who found that there is a statistically significant correlation between increased GGT levels and bile duct stones ($p < 0.05$).

5.8 Profile of Bile Duct Stone Patients based on Alkali Phosphatase (ALP) Levels

This study showed that bile duct stones are found mostly in patients with normal ALP levels, comprising 71 people (60%) compared to patients with increased ALP levels with 47 people (40%). The results of this study were in line with [8] who found that bile duct stones are more found in patients with normal ALP levels, comprising 59 people (49.17%) compared to patients with increased ALP levels with 61 people (50.83%). Although, the results of this study contradicted [15], [21] who found that bile duct stones are mostly found in patients with increased ALP levels (incidence rate of 231 people [86.2%] and 23 people [82.14%], respectively).

5.9 Profile of Bile Duct Stone Patients based on Total and Direct Bilirubin Levels

This study showed that bile duct stones are mostly found in patients with increased total and direct bilirubin

levels, each with 96 people (81.4%) and 89 people (75.4%), compared to patients with normal total and direct bilirubin levels, each with 22 people (18.6%) and 29 people (24.6%). The results of this study were in line with [14] who reported 47 people (18.5%) of choledocholithiasis patients with increased total bilirubin levels.

A retrospective study by [15] stated that increased total bilirubin levels can be a predictor of bile duct stones whereas increased total bilirubin levels can predict the dilatation of bile duct found in ultrasound or ERCP in choledocholithiasis patients. A total bilirubin level of > 4 mg/dl in a patient undergoing ERCP showed a correlation to the risk of choledocholithiasis (OR: 1.79, 95% CI: 1.04-3.08) and showed a statistically significant correlation to choledocholithiasis ($p = 0.001$). A higher level of serum bilirubin (> 4 mg/dl) indicated higher specificity (70.8%) and lower sensitivity (42.5%) to choledocholithiasis [15], [22].

6. CONCLUSION

The profile of choledocholithiasis patients in Dr. Wahidin Sudirohusodo General Hospital Makassar in November 2021-November 2022 is mostly men, has prediabetic status, and have increased levels of AST/SGOT, ALT/SGPT, GGT, total bilirubin, and direct bilirubin.

7. REFERENCES

- [1] Wu Y, Xu CJ, Xu SF. Advances in risk factors for recurrence of common bile duct stones. *Int J Med Sci.* 2021;18(4):1067-1074.
- [2] Ali S, Ahamad ST, Talpur AS, Parajuli S, Farooq J. Prevalence of Non-insulin-dependent Diabetes Mellitus Among Patients with Cholelithiasis: A Single-centered, Cross-sectional Study. *Cureus.* 2018;10(4).
- [3] Lysandra AZ, Putri Wairooy NA, Ifadha RT, et al. Risk Factor of Dietary Habit with Cholelithiasis. *J Community Med Public Heal Res.* 2022;3(1):1-11.
- [4] Pimpale R, Katakwar P, Akhtar M. Cholelithiasis: causative factors, clinical manifestations and management. *Int Surg J.* 2019;6(6):2133.
- [5] Almadi MA, Barkun JS, Barkun AN. Management of suspected stones in the common bile duct. *C Can Med Assoc J.* 2012;184(8):884-892.
- [6] Tamrakar KK, Bhattarai A, Devakota P. Incidence of choledocholithiasis in gallstone disease. *J Chitwan Med Coll.* 2018;8(1):43-45.
- [7] Bosley ME, Zamora IJ, Neff LP. Choledocholithiasis-a new clinical pathway. *Transl Gastroenterol Hepatol.* 2021;6(9):1-15.
- [8] Li G. Diagnostic value of liver function enzymes for choledocholithiasis. *Int J Clin Exp Med.* 2016;9(7):13014-13020.
- [9] Harish B. A cross sectional study on causes and risk factors of gallstone disease among patients with symptomatic Cholelithiasis. *Int J Nurs Res Pract.* 2014;1(1):20-24.
- [10] Kim SB, Kim KH, Kim TN, et al. Sex differences in prevalence and risk factors of asymptomatic cholelithiasis in Korean health screening examinee: A retrospective analysis of a multicenter study. *Med*

(United States). 2017;96(13):1-7.

[11] Zhang J, Ling X. Risk factors and management of primary choledocholithiasis: a systematic review. *ANZ J Surg.* 2021;91(4):530-536.

[12] Sevinç H, Demir MS, Mercan C, Yüksel F, Çaylan A. the Age and Gender Presentation in the Formations of Gallstones. *Turkish Med Student J.* 2017;4(1):11-13.

[13] Pak M, Lindseth G. Risk factors for cholelithiasis. *Gastroenterol Nurs.* 2016;39(4):297-309.

[14] Tozatti J, Mello ALP, Frazon O. Predictor factors for choledocholithiasis. *Arq Bras Cir Dig.* 2015;28(2):109-112.

[15] Magalhães J. Endoscopic retrograde cholangiopancreatography for suspected choledocholithiasis: From guidelines to clinical practice. *World J Gastrointest Endosc.* 2015;7(2):128.

[16] Nurhikmah R, Efriza E, Abdullah D. Correlation between Increased Body Mass Index and the Incidence of Cholelithiasis in the Digestive Surgery Section of RSI Siti Rahmah Padang Period January-June 2018. *Heal Med J.* 2019;1(2):01-06.

[17] Gyedu A, Adaye Aboagye K, Badu-Peprah A. Prevalence of cholelithiasis among persons undergoing abdominal ultrasound at the Komfo Anokye Teaching Hospital, Kumasi, Ghana. *Afr Health Sci.* 2015;15(1):246-252.

[18] Su PY, Hsu YC, Cheng YF, Kor CT, Su WW. Strong association between metabolically-abnormal obesity and gallstone disease in adults under 50 years. *BMC Gastroenterol.* 2019;19(1):1-6.

[19] Sun H, Tang H, Jiang S, et al. Gender and metabolic differences of gallstone diseases. *World J Gastroenterol.* 2009;15(15):1886-1891.

[20] Lesmana LA. Gallstone Disease. In: *Textbook of Internal Medicine, Volume II.* VI. Interna Publishing, Central Jakarta; 2014:2020-2025.

[21] Kaunang M, Panelewen J, Mambu T. Serum Bilirubin, Alkaline Phosphatase, and Gamma Glutamyl Transpeptidase Levels as Predictors of Choledochal Duct Stones in Symptomatic Gallstone Patients. *J Biomedical.* 2019;11(1):34.

[22] Buxbaum JL, Abbas Fehmi SM, Sultan S, et al. ASGE guideline on the role of endoscopy in the evaluation and management of choledocholithiasis. *Gastrointest Endosc.* 2019;89(6):1075-1105.e15.