

Gallstones: Site, Size, Number, Prevalence and Complications by Ultrasonography

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Abstract: This study was undertaken to determine the common sites, sizes, number, complications and the prevalence of gallstones at Almadinah Almunawwarah in Saudi Arabia that is a common medical problem in this region even in young adults and not satisfied by enough previous studies. This was a descriptive retrospective study in which screening of 1018 case from the PACS system was done for gallstones. Those patients were subjected to abdominal ultrasound (US) imaging. The collected data analyzed by using the Microsoft word 2013 and SPSS. The prevalence of gallstones in this study is 18-23.5% and exactly 69.57% of gallstones were in females and 30.43% in males. Gallstones increase with age to peak in elderly. Approximately 58.15% of gallstones were multiple stones in the gallbladder and 39.13% were solitary stone. Nearly 61.41% were mobile stones in the gallbladder, 11.41% were impacted stones in the neck of the GB and 13% of the gallstones were filling the whole lumen of the GB. Approximately 60.66% of gallstones were 5 to 20 mm in the largest diameter, 20.77% less than 5 mm and only 15.30% were larger than 20 mm. The conclusion is gallstones are a common problem in Saudi Arabia and the ratio of cholecystectomy is high. Gallstones affect female twice as they affect males. Multiple stones of the GB are more common than solitary. Most cases of gallstones are mobile stones, filling the GB or impacted in the neck of the gallbladder. Most cases of gallstones are 5-20 mm in size.

Keywords: Gallstones, Ultrasonography, Cholecystitis, Almadinah Almunawwarah

1. Introduction

Gallstones constitute one of the most common health problems in the world. They affect approximately 10 to 15% of adult populations of the United States American and the prevalence increases with age to be approximately 30% over 70 years old. However, the majority of cases of gallstones remain silent; cholecystectomy is one of the most common surgical procedures in the world. Many risk factors are contributing for formation of the gallstones including female gender, family history, pregnancy, obesity, rapid loss of weight, increasing age, liver cirrhosis and crohn's disease. Gallbladder stones are rare in children but may present in Childs of obesity and chronic hemolytic anemias as in Sick cell anemia [1].

Gallstones can cause a lot of complications as likely as biliary colic, Acute Calcular Cholecystitis, Emphysematous cholecystitis, hydrops gallbladder, Perforated cholecystitis, Gallstones ileus, Mirizzi's syndrome and gastric outlet

obstruction (Bouveret's syndrome) [2, 3].

Acute cholecystitis is an inflammation of the wall of the gallbladder that is an important abdominal emergency caused by gallstones in more than 90% of cases "Acute Calcular Cholecystitis" that is more common in females than in males with about 3:1 male to female ratio before the age of 50 years old but it has similar incidence at higher age. Ultrasonography is the most accurate imaging method for diagnosis of acute cholecystitis [3].

Ultrasonography is the first choice imaging modality for diagnosis of gallstones. It is a safe, non-invasive and very effective method to detect gallstones and it is the first choice for diagnosis of acute cholecystitis. It can easily confirm or exclude gallstone disease with more than 95% sensitivity and specificity for diagnosis of gallstones. Ultrasound sensitivity for diagnosis of stones in the common bile duct (CBD) is approximately 50% and it can diagnose only half cases of CBD stones [2, 4].

Gallbladder cancer is more common in patients with

gallstones than in patients with no gallstones (69% vs. 23%) [5]. The size of the gallstones is important and there is a strong relationship between the size of gallstones and gallbladder cancer [6]. There is a significant correlation between gallbladder cancer and large size and solitary gallstone also [7]. This gives the importance of study of the size, number and site of gallstones that we did in this study.

Gallstones can get any size, from tiny size as a grain of sand to large size as a golf ball and the patients are common to have multiple small stones, a solitary large stone or a combination of sizes. In this study, we calculated the size of the largest stone in the gallbladder either solitary stone or the largest one in multiple gallstones and put the stones in 4 groups; tiny stones (less than 5mm), small stones (5mm to 10mm), medium stones (11mm to 20mm) and large stones (larger than 20mm). In this study, we studied the site of gallstones and classified gallstones into six groups; mobile stones, impacted stones in the neck of the gallbladder, stones filling the whole lumen of gallbladder, contracted gallbladder with stones, stones in the cystic duct or in the common bile duct (CBD). We also studied the number of gallstones in all cases and put them in 4 groups; solitary stone, two stones, three stones or multiple stones.

2. Patients and Methods

2.1. Study Population

This retrospective study was conducted at the Prince Mohammed Bin Abdulaziz hospital (PMAH) National Guard in Almadinah Almunawwarah in the Kingdom of Saudi Arabia.

This study was approved by the Ethics Committee of the Faculty of Applied Medical Sciences at Taibah University in Almadinah Almunawwarah and after taking permission from the head of the hospital and the head of the Medical Imaging department in the hospital; screening of 1018 case of abdominal ultrasonography from the PACS system those were done during the period of 1 February to 31 July 2016. There were 1018 patients of different ages who came to the Medical imaging department and subjected to ultrasound imaging of the abdomen by six highly qualified Radiologic Technologists and diagnoses of these cases were done by highly qualified Clinical Radiologists in the hospital.

2.2. Technique of Ultrasound Imaging

In abdominal ultrasound imaging, patients should be fasting for 8 hours at least and examination starts with patients in supine position on the table with holding full inspiration and they may need to be turned on to the left side or examined on erect position or on hands and knees position. Transabdominal ultrasound to detect gallstones was done using the subcostal sweep approach with the patient taking deep inspiration, the X-minus 7 intercostal approach or by the fan approach. In this study ultrasound imaging was done by using high quality Philips ultrasound machines and 3.5MHz or 5MHz curvilinear transducers for thin adults and

children were used with a good coupling gel to get a good contact with the skin of the patients. Proper setting of the time gains compensation (TGC) and the depth gain compensation (DGC) was done to optimally visualize the gallbladder and the common bile duct (CBD) and to get high quality B mode gray-scale ultrasound images.

2.3. Data Analysis

The collected data analyzed by using the Microsoft word 2013 and SPSS. The results of this study contain quantitative variables those were easily described using numbers, percentages, figures and tables.

3. Results

From 1018 patients who did abdominal ultrasound imaging, there were 758 persons (74.5%) with normal gallbladder, 184 patients (18%) with gallstones, 56 patients (5.5%) post-cholecystectomy and 20 patients (2%) the gallbladder could not be seen by ultrasound imaging of the abdomen. Figure 1

The gallstones were 128 (69.57%) in female patients and 56 (30.43%) in male patients that showed a strong tendency to affect females. Figure 2

The prevalence of gallstones increases with increase age as showed in this study as the following: 3 patients (1.63%) were in the first decade of life, 1 patient (0.5%) in the second decade of life, 29 patients (15.76%) in the third decade of life, 32 patients (17.93%) in the fourth decade of life, 30 patients (16.30%) in the fifth decade of life, 34 patients (18.48%) in the sixth decade of life and 55 patients (29.89%) were in patients more than 60 years old age. Table 1

In this study, 56 patients (5.5%) of the whole 1018 patients in the sample were having history of cholecystectomy. The patients of cholecystectomy were distributed according to the age as follows: 1 patient (1.78%) of them was in the 2nd decade of life, 4 patients (7.14%) were in the 3rd decade, 4 patients (7.14%) were in the 4th decade, 7 patients (12.5%) were in the 5th decade, 15 patients (26.78%) were in the 6th decade and 25 patients (44.64%) of them were in older age than 60 years.

In this study, 107 cases (58.15%) were having multiple stones in the gallbladder, 72 cases (39.13%) were having solitary stone, 3 cases (1.63%) were having two stones and only 2 cases (1.08%) were having three stones in the gallbladder. Figure 3

According to the site of gallstones, 113 cases (61.41%) of gallstones in this study were mobile stones in the gallbladder, 21 case (11.41%) were impacted stones at the neck of the gallbladder, 24 case (13.04%) of the gallstones were filling the whole lumen of the gallbladder, 24 case (13.04%) were stones in the lumen with contracted gallbladder, 1 cases (0.53%) were stones in the common bile duct (CBD) and only one case (0.53%) was in the cystic duct. Figure 4

The size of the largest gallstone was 5-10 mm in 57 cases (31.15%), 11-20 mm in 54 case (29.51%), less than 5mm in 38 case (20.77%), 20-30 mm in 24 case (13.11%), larger than

30 mm in 4 cases (2.19%) and different sizes in 6 case (3.28%) of the sample. Figure 5

Acute Calcular Cholecystitis was a complication in 20 patients (10.33%), Obstruction of the gallbladder with sludge was a complication in 20 patients (10.33%), and Chronic Cholecystitis was a complication in 14 patients (7.60%) and CBD stones were a complication in 1 patient (0.54%) and Figure 6

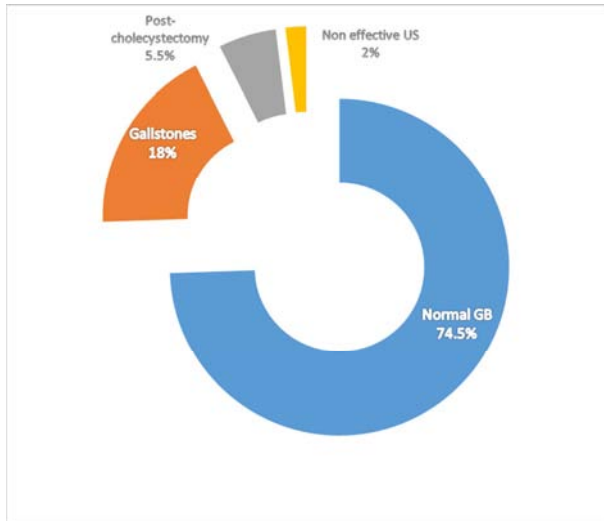


Figure 1. The % of gallstones in the sample persons.

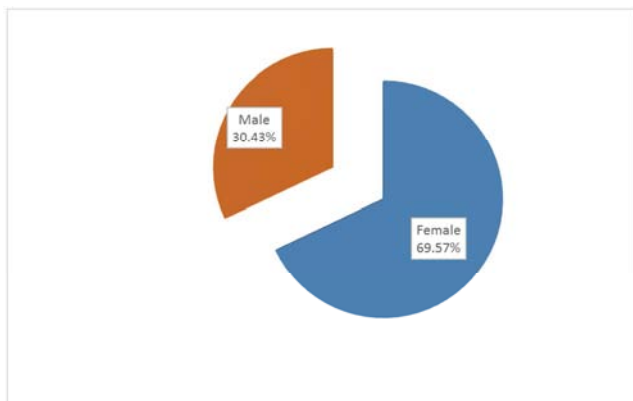


Figure 2. Distribution of the gallstones according to the gender.

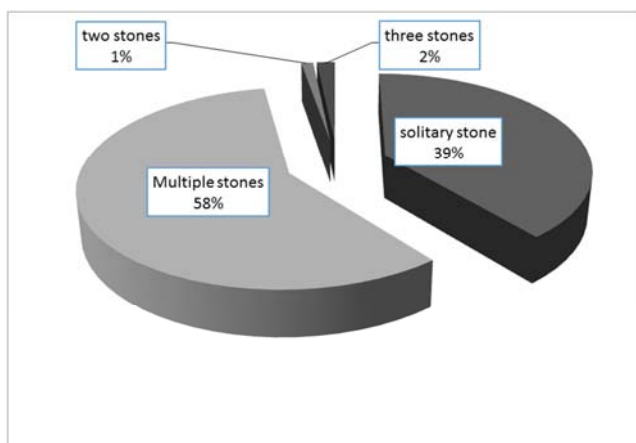


Figure 3. Distribution of the gallstones according to the number of stones.

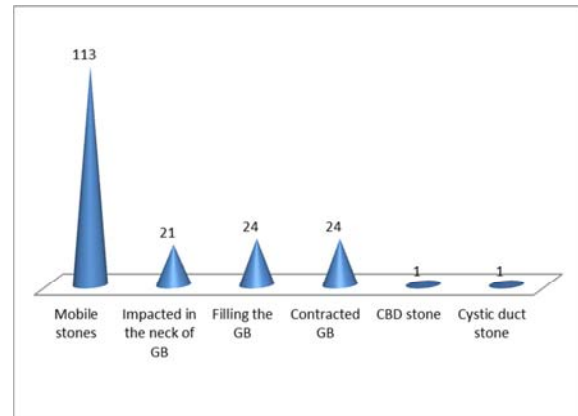


Figure 4. Distribution of the gallstones according to the site of stones.

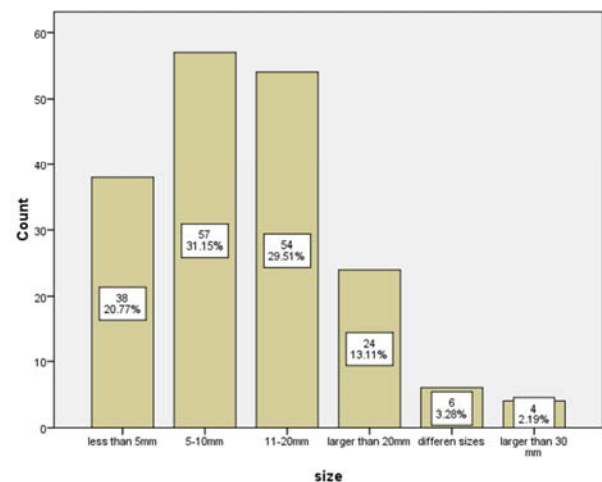


Figure 5. Distribution of the gallstones according to the size of stones.

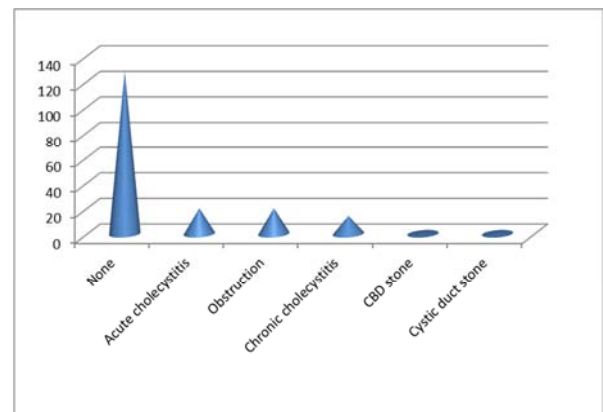


Figure 6. Common complications of the gallstones.

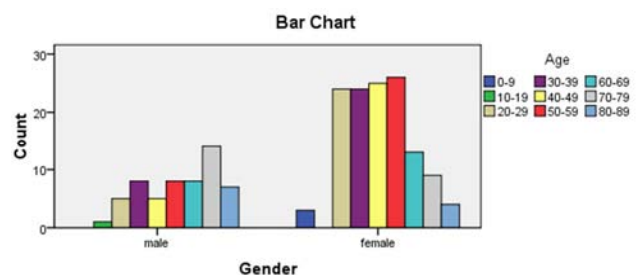


Figure 7. Distribution of gallstones in age groups with gender.

Table 1. Distribution of gallstones in age groups with gender in number and %.

Gender * Age Cross tabulation												
			Age									Total
			0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	
Gender	male	Count	0	1	5	8	5	8	8	14	7	56
		% within Gender	.0%	1.8%	8.9%	14.3%	8.9%	14.3%	14.3%	25.0%	12.5%	100.0%
	female	Count	3	0	24	24	25	26	13	9	4	128
		% within Gender	2.3%	.0%	18.8%	18.8%	19.5%	20.3%	10.2%	7.0%	3.1%	100.0%
Total	Count		3	1	29	32	30	34	21	23	11	184
	% within Gender		1.6%	.5%	15.8%	17.4%	16.3%	18.5%	11.4%	12.5%	6.0%	100.0%

Table 2. Chi-square Test shows P-value of: .001.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.252 ^a	8	.001
Likelihood Ratio	26.232	8	.001
Linear-by-Linear Association	15.831	1	.000
N of Valid Cases	184		

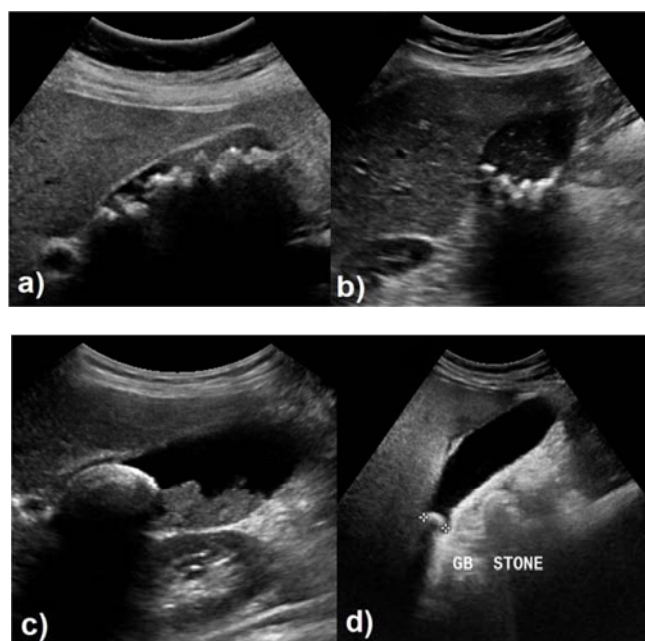


Figure 8. Ultrasound images of gallstones for different patients. Four images are a) Multiple stones filling the lumen of the gallbladder (GB) with obvious acoustic shadows, b) Multiple tiny mobile stones in the lumen of the GB with sludge formation, c) Large stone impacted in the neck of the GB and complicated with sludge formation in the GB, and d) Small stone impacted in the neck of the GB complicated by acute calculous cholecystitis that manifested by thickened wall of the GB with minimal pericholecystic fluid collection.

4. Discussion

This study of gallstones was done at Almadinah Almunawwarah in the Kingdom of Saudi Arabia in which 1018 patient were subjected to abdominal ultrasonography and divided according to the results into 4 groups: 758 (74.5%) gallstone-free subjects, 184 (18%) patients with gallstones, 56 (5.5%) patients with previous cholecystectomy and 20 (2%) patients with non-visible gallbladder due to different causes other than cholecystectomy as excessive

gases in the bowels or others.

In this study, gallstones were affecting 18-23.5% of population in the sample persons (12.6-16.4% female: 5.4-7.1% male). These results are higher than the results of Laura M. Stinton who reported that gallstones affecting 10%-15% of adult population in the United States American, intermediate prevalence rates occur in Asian populations (13.9% of women: 5.3% of men) and the lowest frequency rates of gallstones occur in Sub-Saharan Black African (less than 5%) [1].

The prevalence of gallstones in this study is lower than that in American Indians (18-23.5% vs. 60-70%) depend on Sinton LM who reported that the prevalence of gallstones is high as 60% to 70% in American Indians and 10% to 15% in white adults of developed countries with high ethnic differences shows low frequency in black Americans and those from East Asia and also rare in sub-Saharan Africa [8].

The prevalence of gallstones in this study is higher than that in Italian (18% vs. 8.4%) but the percent of cholecystectomy is slight higher in Italian (5.6% vs. 5.5%) according to Festi D who did a similar study on 29,504 subjects and reported that 86% were gallbladder-free subjects, 8.4% were patients with gallstones and 5.6% were patients with history of previous cholecystectomy for gallstones [9].

This study revealed that the frequency of gallstones increases with increase age of patients from 1.63% in the first decades of life to be 15.8% in the third decade and increase to be marked in the fourth, fifth and sixth decades of life (17.4%, 16.3% and 18.5% respectively). The prevalence of the gallstones was approximately 10-11 times more in the 4th decade of life than in the 1st decade of life (1.63% vs. 17.4%). These results are similar to Laura M. Sinton who reported that the frequency of gallstones increases with age and increase markedly after 40 years old age to become 4-10 times more likely in older age [1]. These results explained by the study that was done by Einarsson K. who concluded that hepatic secretion of cholesterol and cholesterol saturation of bile increases with increase age that is a risk factor for development of gallstones [10].

The study revealed that gallstones were more common in female (69.57%) than in men (30.43%). This result is similar to the result of Laura M. Sinton who reported that women are almost twice as likely as men to form stones especially during the fertile years [1]. This result also similar to Novacek G who reported that the rates of gallstones are

higher in female than in male by two to three times [11]. There is a strong relationship between gallstones and gender of the patient with strong tendency to affect females (p-value= 0.001).

According to AIJAZ AHMED who reported that Acute Cholecystitis is a complication in 10% of cases of gallstones [2], Acute Calcular Cholecystitis was a complication in 10.33% of gallstones cases in this study and these results are nearly equal. The previous results are depending on Boboev BD who reported that transabdominal ultrasonography has 98.8% accuracy for Acute Calcular Cholecystitis and 68.5% accuracy for CBD stones [12].

Diagnostic ultrasonography allowed easy determination of the prevalence of gallstones in different samples of population in the world. Sutton reported that ultrasonography is the best method to screen for the prevalence of gallstones with over 98% accuracy [4]. The result of accuracy of Sutton was as the result in this study in which, ultrasonography was effective in screening of 98% of cases of the sample. The result in this study is nearly equal to that of Hessler PC, who reported that transabdominal gray-scale sonography, has an accuracy rate of 98.6% for positive diagnosis of gallstones [13].

In this study, exactly 60.87% of gallstones were mobile stones, 13% were impacted stones at the neck of gallbladder, 13% were filling the GB, and 13% were stones in contracted GB. The study also revealed that 61.95% were multiple stones in the GB and 34.78% were solitary stones in the GB. These are the new finding discovered in this study and there are no previous similar studies for comparison with these results.

According to the size of the gallstones, this study revealed that 29.51% of gallstones were between 11 and 20 mm in the largest diameter, 31.15% in the range of 5 to 10 mm, 20.77% less than 5 mm, 13.11% in the range of 20 to 30 mm and only 2.19% were larger than 30 mm. This is a new numbers reported by this study of the gallstones and unfortunately, there are no similar previous studies for comparison.

5. Conclusion

From 1018 patients who subjected to transabdominal ultrasound imaging in this study, exactly 74.5% were gallstone-free subjects, 18% were have gallstones, 5.5% were patients with history of cholecystectomy and only 2% ultrasound was non-effective to imaging the gallbladder. The prevalence of gallstones increases with age to be 10 times more common in the 4th decade of life than it in the 1st decade. Gallstones are more common in female gender than in male (69.57% vs. 30.43%). Multiple gallstones are more common than solitary gallstone (58.15% vs. 39.13%). Most cases of gallstones are mobile stones, impacted stones at the neck of the gallbladder, gallstones filling the gallbladder, intra-lumen gallstones with contracted gallbladder and the least are stones in the common bile duct. Approximately

29.51% of the gallstones were 11 to 20 mm in the largest diameter, 31.15% in the range of 5 to 10 mm, 20.77% less than 5 mm, 13.11% in the range of 20 to 30 mm and only 2.19% of gallstones were larger than 30 mm. The most common complication could be diagnosed by ultrasonography is Acute Calcular Cholecystitis and obstruction of the gallbladder.

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