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Original Research Article

A cross sectional study on the risk factors of gallbladder stone

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ABSTRACT

Background: Gallstone diseases are one of the most common public health problems. Approximately 10%-20% of the national adult populations currently carry gallstones, and gallstone prevalence is rising. The purpose of the study was to find out association of gallstone with fatty liver, gender and age in Lahore, Pakistan.
Methods: Ultrasonographically Hundred patients were scanned for liver type and gall stone. The data was analyzed by using SPSS version 17.0. Chi-Square statistics was used to check the association between the variables. The effect of age and gender was also statistically analysed.
Results: One hundred patients were scanned between ages 21-60 years. Out of hundred 76% patients were female and 24% were male. In this study there were no stones in 37% cases and there were stones in 63% cases. Gallbladder stone found associated with age as p-value is found less than 5% level of significance, maximum patients were found in age ranges between 31-35 years, showing that risk of developing gallstone increases by age. Gallstone is gender specific, females are more victims of developing the stone than among males, and those who have fatty liver are more at risk of developing gallstone than those having normal liver.
Conclusions: The study showed that ultrasound (US) is the most sensitive, specific, yet very practical and useful imaging test for the detection of gallstones with a high degree of confidence. Gallstones represent high prevalence disease in adult females more than males and it increases by age where as those who have fatty liver, they are more likely to develop gallstone.

Keywords: Cross-sectional study, Fatty liver, Gallstones, age, Gender

INTRODUCTION

Gallstone diseases are one of the most common public health problems. Approximately 10%-20% of the national adult populations currently carry gallstones, and gallstone prevalence is rising. In addition, nearly 750,000 cholecystectomies are performed every year in the United States; crude costs of gallbladder surgery are estimated to be $6.5 billion.[1,2]

Cholelithiasis is also strongly associated with gallbladder, pancreatic and colorectal cancer occurrence. Moreover, the National Institutes of Health estimates that almost 3,000 deaths (0.12% of all deaths) per year are attributed to complications of cholelithiasis and gallbladder disease. Although extensive research has tried to identify risk factors for cholelithiasis, several studies indicate that definitive findings still remain elusive.[3]

In this review, predisposing factors for cholelithiasis are identified, the pathophysiology of gallstone disease is described, and nonsurgical preventive options are discussed. Understanding the risk factors for cholelithiasis may not only be useful in assisting nurses

to provide resources and education for patients who are diagnosed with gallstones, but also in developing novel preventive measures for the disease.[1] The gallbladder is a pear-shaped organ which lies just beneath the liver on the right side of the abdomen. Measuring approximately 3 to 4 inches long and about 1 inch wide, the gallbladder's main function is to store and concentrate bile which is produced in the liver. Bile, a bitter, greenish mixture of acids, salts and other substances is carried by the bile ducts which connects the liver and the gallbladder. Bile aids in the digestion of fat, and is released from the gallbladder into the upper small intestine (duodenum) in response to food (especially fats). For more information see Liversupport.com.[4]

Gallbladder is divided into three parts fundus, body and neck. Cystic duct arises from gallbladder which then joins with hepatic duct to form Common bile duct. Variations in the shape of gallbladder are common. There are frequently one or more junctional folds in the gallbladder neck. The gallbladder fundus fold on itself is called Phrygian cap.[2] The association between fatty liver disease and gallstones is based upon risk factors and metabolic derangements that are common to both conditions. Modifiable risk factors for gallstones and fatty liver include obesity and metabolic syndrome, both of which can be addressed with weight loss, exercise and dietary modifications such as a low-fat, low-sugar diet. You also can at least partly address other conditions that increase your risk for fatty liver and gallstones – type 2 diabetes and high triglyceride levels – through these same lifestyle changes. If you suffer from type 2 diabetes, metabolic syndrome or obesity, ask your doctor how you can protect yourself from gallstones and fatty liver disease.[3]

METHODS

The cross-sectional study was conducted on 100 patients using ultrasonography from different hospitals at Lahore, who come with the complain of epigastria and right upper quadrant pain. Liver type was observed on longitudinal view while patient lying in spine position. Gallbladder was identified and viewed in the transverse & sagittal plane while patient lying in the left lateral decubitus position. The results were analyzed by using Chi-Square statistics on software SPSS version 17.0.

RESULTS

In studying the association of fatty liver with gall stone on the basis of ultrasound, mean age of the participants with standard deviation was found to be 38.33±9.374 years. The maximum age of the participants was found in the range 41-45 years and the bar diagram has shown the same distribution of age.

Table 1: Descriptive statistics.

	N	Minimum	Maximum	Mean	Std. Deviation
Age in years	100	21	60	38.33	9.374
Gender	100	1	2	1.76	0.429
Liver type	100	0	1	0.68	0.469
Gallbladder stone	100	0	1	0.63	0.485
Valid N (list wise)	100				

Table 2: Frequency table.

Age	Frequency	Percent	Valid percent	Cumulative percent
21-25	9	9.0	9.0	9.0
26-30	16	16.0	16.0	25.0
31-35	21	21.0	21.0	46.0
36-40	13	13.0	13.0	59.0
41-45	20	20.0	20.0	79.0
46-50	12	12.0	12.0	91.0
51-55	7	7.0	7.0	98.0
56-60	2	2.0	2.0	100.0
total	100	100.0	100.0	

Out of 100 cases 24 were male and 76 were females. In studying the type of liver, 68 out of 100 cases were having fatty liver while 32 were with non-fatty liver. Gallbladder stone was found among 63 cases and was absent in 37 participants. The same distribution can be seen by bar charts. In cross tabulation of age and gallbladder stone, it was found that 16 (16%) of the cases having gallbladder stone ranges from 31-35 years of age

and of 41-45 years of age. Chi Square test is applied in order to check the association between age and gallbladder stone, the value of chi square was 47.948 with p-value 0.027 showing significant association between age and gallbladder stone.

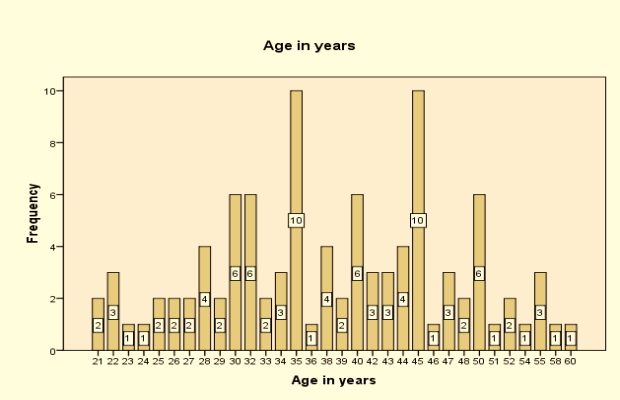

Figure 1: Frequency distribution of age.

In cross tabulation of gender and gallbladder stone 46 (46%) of females and 17 (17%) of males out of 100 (100%) cases were found with gallbladder stone. Chi square value for these variables is 0.831 with p-value 0.036 showing significant relation between gender and the gallbladder stone. Females are more likely to develop gallbladder stone than males.

When the variable liver type cross tabulated with the gallbladder stone, it was found that out of 100 (100%) cases, 44 (44%) cases having fatty liver while 19 (19%) with non-fatty liver.

Pearson Chi Square value 0.265 with p-value 0.041 showing a significant association between liver type and gallbladder stone. Those who have fatty liver are much likely to develop gallbladder as compared to the non-fatty liver type of persons. The distribution of the variables can also be seen by the bar charts.

Table 3: Frequency distribution of gender.

		Frequency	Percent	Valid percent	Cumulative percent
Valid	male	24	24.0	24.0	24.0
	female	76	76.0	76.0	100.0
	Total	100	100.0	100.0	

Table 4: Frequency distribution of Liver type.

		Frequency	Percent	Valid percent	Cumulative percent
Valid	Non-Fatty	32	32.0	32.0	32.0
	fatty	68	68.0	68.0	100.0
	Total	100	100.0	100.0	

Table 5: Frequency distribution of gallbladder stone.

		Frequency	Percent	Valid percent	Cumulative percent
Valid	No	37	37.0	37.0	37.0
	yes	63	63.0	63.0	100.0
	Total	100	100.0	100.0	

DISCUSSION

Bile is produced in the liver and stored in gallbladder. From liver right and left hepatic duct arises, unite with each other to form common hepatic duct which then combines with cystic duct which arises from gallbladder. Cystic duct and common hepatic duct combine together to form common bile duct.[4,5] The gallbladder has capacity of 30-50 ml to store bile. When digestion is not taking place, the sphincter of oddi remains closed and bile accumulates in gallbladder. The gallbladder concentrates bile, selectively absorbs bile salts keeping the bile acid, excretes cholesterol, and secretes mucus. To aid in these functions the mucous membrane is thrown into permanent folds that unite with each other, giving the surface a honeycombed appearance.

The columnar cells lining the surface have numerous microvilli on their free surface. Bile is delivered to the duodenum as the result of contraction and partial emptying of gallbladder. This mechanism is initiated by the entrance of fatty foods into the duodenum. The fat cause's release of hormone cholecystokinin from the mucous membrane of the duodenum, the hormone then

enters the blood, causing the gallbladder to contract.[7-9] At the same time, the smooth muscle around the distal end of the bile duct and the ampulla is relaxed, thus allowing the passage of concentrated bile into the duodenum. The bile salts in the bile are important in emulsifying the fat in the intestine and in assisting with its digestion and absorption Gallstones are pieces of solid material that form in the gall bladder these stones develop because cholesterol and pigments in bile sometime form hard particles.[4] Two main types of gall stones are cholesterol stones and pigment stones. Cholesterol stones are usually yellow green color approximately 80% of gallstones are cholesterol stones. Pigment stones are smaller and darker and are made up of bilirubin.[5]

Table 6: Gallbladder stone with respect to age in years.

Age (years)	Gallbladder stone		Total
	No	Yes	
21-25	8 (8%)	1 (1%)	9 (9%)
26-30	11 (11%)	5 (5%)	16 (16%)
31-35	5 (5%)	16 (16%)	21 (21%)
36-40	2 (2%)	11 (11%)	13 (13%)
41-45	4 (4%)	16 (16%)	20 (20%)
46-50	6 (6%)	6 (6%)	12 (12%)
51-55	1 (1%)	6 (6%)	7 (7%)
56-60	0 (0%)	2 (2%)	2 (2%)
total	37 (37%)	63 (63%)	100 (100%)

Table 7: Chi-square tests of gallbladder stone with respect to age in years.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	47.948	31	0.027
Likelihood Ratio	59.289	31	0.002
Linear-by-Linear Association	14.143	1	0.000
N of Valid Cases	100		

Table 8: Cross-tabulation of gallbladder stone with respect to gender.

			Gender		Total
			Male	Female	
Gallbladder stone	No	Count	7	30	37
		% of Total	7.0%	30.0%	37.0%
	Yes	Count	17	46	63
		% of Total	17.0%	46.0%	63.0%
Total		Count	24	76	100
		% of Total	24.0%	76.0%	100.0%

Table 9: Chi Square test on gender and gallbladder stone.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	0.831	1	0.036		
Continuity correction	0.448	1	0.503		
Likelihood ratio	0.852	1	0.356		
Fisher's exact test				0.0469	0.0254
Linear-by-linear association	0.823	1	0.364		
N of valid cases	100				

Gallstone disease is also related to other diseases like cardiovascular risk factors; however, whether presence of gallstones predicts coronary heart disease (CHD) is not well established.[6] Gallstones may be present at any age

but are unusual before the third decade. The prevalence of gallstones is strongly influenced both by age and gender. There is a progressive increase in the presence of gallstones with age but the prevalence is two to three times higher in women than in men, although this difference is less marked in the 6th and 7th decade. At this age, the prevalence ranges between 25% and 30%. The increase in life expectancy is reflected in an increased burden of symptomatic gallstone disease. There are considerable racial differences, gallstones being more common in Scandinavia, South America and Native North Americans but less common in Asian and African groups.[10]

The large majority of gallstones are of two types: cholesterol (containing >50% of the cholestrol) and less frequently 'pigment stones', being predominantly composed of calcium bilirubinate or polymer-like complexes with calcium, copper and some cholesterol. Gallstones are diagnosed on US by the presence of gravity-dependent, mobile, echogenic foci within the gallbladder lumen that cast a posterior shadow.[9]

Table 10: Cross-tabulation of gallbladder stone with respect to liver type.

			Liver type		Total
			Non-Fatty	Fatty	
Gallbladder stone	No	Count	13	24	37
		% of Total	13.0%	24.0%	37.0%
	Yes	Count	19	44	63
		% of Total	19.0%	44.0%	63.0%
Total		Count	32	68	100
		% of Total	32.0%	68.0%	100.0%

Table 11: Chi-square test of gallbladder stone with respect to liver type.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	0.265	1	0.041		
Continuity correction	0.086	1	0.769		
Likelihood ratio	0.264	1	0.608		
Fisher's exact test				0.0660	0.0382
Linear-by-linear association	0.263	1	0.608		
N of valid cases	100				

Although ultrasound has been demonstrated to have an accuracy (>95%) for the identification of gallstones, stones that are too small, (usually<1mm to cast a posterior shadow soft stones lacking strong internal echoes, or gallstones impacted in the gallbladder neck or in the cystic duct that may not be as readily detectable on US examination as they silhouette with the surrounding echogenic bowel gas or intra peritoneal fat. If the gallbladder is focally tender but no gall stones are appreciated, the patient should be examined from multiple positions and scanning planes, including prone, upright and decubitus positions and intercostal scanning, to facilitate complete visualization of the neck of the gallbladder.

Harmonic imaging significantly improves visualization of small gallstones. This type of ultrasound transmits the insonating USG beam at a fundamental frequency, such as 2.5 or 3 MHz, and receives the returning echoes not only at the fundamental frequency but also at the second harmonic frequency that is twice the fundamental frequency creating the image with the higher harmonic frequency. By eliminating the fundamental frequency this technique significantly reduces degradation of the image by noise, since lower frequencies easily can be filtered out. In addition, scattering of the USG beam from fat in the anterior abdominal walls diminished because the harmonic frequencies are generated after the beam enters the body. The narrower harmonic beam also has fewer side lobes, and therefore, improved lateral resolution and signal to noise ratio. Harmonic imaging increases the echogenicity of gallstones and strengthens their posterior shadows; permitting visualization of stones not seen with conventional gray scale visualization of stones is spatial compounding. Multiple images are acquired slightly off axis from one another, which increases the signal from the persistent echoes that comprise the image and blurs out some of the random noise. The disadvantage of compounding is that posterior shadowing is diminished, which may be a better visual cue to detect typical gallstones than the actual echoes from the stones themselves.[10,11]

Other stones such as soft pigment stones may not shadow with any technique. Soft pigment stones are less echogenic than the more common cholesterol gallstones and may simulate soft tissue masses. Pigmented stones are commonly associated with recurrent pyogenic cholangiohepatitis and are more often seen in the bile ducts than in the gallbladder. Because of their lack of shadowing, they may be misinterpreted as sludge or debris and result in a false negative examination. False positive US diagnosis of gallstones may occur secondary to side lobe artifacts that can generate echoes appearing to arise within the gallbladder lumen but actually originate from the wall or outside the wall. Similarly, gas in adjacent bowel can create a brightly echogenic mass-like area with posterior shadowing, which appears to be within the gallbladder lumen because of a partial volume artifact and thereby mimics gallstones.

A calcium bile salt precipitate may form in patients taking the antibiotic ceftriaxone and may mimic gallstones on sonographic examination. These precipitates resolve after the patient ends therapy. Other fluid-containing structures such as the duodenum, gastric antrum, colon, hematomas, pancreatic pseudocysts, or even dilated vascular collaterals may be mistaken for the gallbladder on US examination, especially if the gallbladder is out of its normal position or is small and contracted. Mistaking these structures for the gallbladder may result in missing pathology in the true gallbladder or a false-positive diagnosis of gallbladder disease (ie, obstructed gallbladder or acalculous cholecystitis.[7-9]

After conducting a study on association of fatty liver and gallbladder stone, the data was collected from 100 participants and was analyzed by using SPSS version 17.0. The study was aimed at investigating the association of liver type with the gallbladder stone. The results showed a significant association between the gallbladder stone and liver type. Fatty liver persons develop gallbladder stones much more than the persons with non-fatty liver.

Gall stone is also associated with age. By increasing age, the chances of developing gall stones also increased. The present study has shown that 16 (16%) of participants ranges from 31-35 and 41-45 years of age were at maximum range who have developed stone. When gallstone is related to gender, it is cleared that there exists significant difference gender wise as females are 46 (46%) and males 17 (17%) out of 100 (100%) cases. Chi square analysis showed a significant association between gender and gallbladder stone. Males are less likely to develop gall stone than females

The association in all the three variables is significant as their p-values are less than 5% level of significance (α=0.05).

CONCLUSION

The study showed that ultrasound (US) is the most sensitive, specific, yet very practical and useful imaging test for the detection of gallstones with a high degree of confidence. Gallstones represent high prevalence disease in adult females more than males and it increases by age where as those who have fatty liver, they are more likely to develop gallstone.

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