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Determination of transverse diameter and longitudinal axis in patients with cholecystitis and cholelithiasis by computed tomography to rule out gallbladder carcinoma

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ABSTRACT

The aim of the article is to the determination of transverse diameter and longitudinal axis in patients with cholecystitis and cholelithiasis with the help of CT scan in the north Indian population for the estimation of epidemiology. Patients with cholecystitis and cholelithiasis of ages between 17-80 years irrespective of gender were included in the study (cases). All patient's cases (100) and controls (100) were advised the night before that did not eat or drink. Control groups (Normal Gallbladder) were collected when patients are comprised of other abdominal disease diagnosed by computed tomography. The mean age of controls and cases was 47.24±11.57 and 45.20±16.22 years, respectively studied by computed tomography. More than half of cases (62%) and 50% of controls were females. The transverse diameter was significantly (p=0.0001) higher among cases (36.42±15.52 mm) than controls (24.12±9.11 mm) studied by computed tomography. Longitudinal axis was significantly (p=0.0001) higher among cases (33.23±14.73 mm) than controls (21.75±8.69) studied by computed tomography. Transverse diameter>25 correctly predicted cholecystitis and cholelithiasis by CT in 38.5% cases with sensitivity and specificity of 77% (95%CI=68.8-85.2) and 74% (95%CI=55.7-74.3%) respectively. Longitudinal axis >25 correctly predicted cholecystitis and cholelithiasis by CT in 34.5% cases with specificity and sensitivity of 69% (95%CI=59.9-78.1) and 71% (95%CI=62.1-79.9%) respectively. We concluded in this study, increased transverse diameter and longitudinal axis were observed. Good sensitivity and specificity of these two parameters were also found in predicting cholecystitis and cholelithiasis by computed tomography.

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INTRODUCTION

The gallbladder is stimulated to contract the bile and eject the bile into the duodenum by the hormone cholecystokinin pancreozymins (CCK) formed by the endocrine cells of duodenal mucosa in response to food (Williams and CB, 2008). The mucosa protects the inner surface of the bladder along with simple columnar epithelium by microvilli, muscularis mucosa. The submucosa is absent in gallbladder. Mucous glands are only present in the neck region of the gallbladder (Mohan, 2005). Cholelithi-

asis has been observed in Egyptian mummies dating as far back as 3400 BC. It seems that Charaka (2nd century BC) and Sushruta (6th Century BC) from India were also acquainted with this disease of the biliary tract (Mathur *et al.*, 2012). The severity of gallstone disease has previously been shown to related to gallstone type and particularly septic complications much more common in patients with pigment gallstones than patients with cholesterol gallstones (Mohan, 2005; Bernhoft *et al.*, 1984) Gallstones are a significant cause of morbidity and mortality throughout the world, cholecystitis and cholelithiasis are very common particularly in females nearly 40 years, fatty and fertile (Singh and Singh, 2017). Abdominal ultrasound among patients of carcinoma gallbladder is the first and most common imaging modality employed having with various limitations. CT scan provides accurate information about the invasion into the adjacent organs, biliary tree and portal vein involvement. MRI is used in non-operable patients to delineate the biliary tract anatomy among patients who are considered for palliative stenting (Fong *et al.*, 2001). CT scan of acute cholecystitis involves gallbladder wall thickening, pericholecystic inflammatory change, pericholecystic fluid, gallbladder wall enhancement. There is an increasing utilization of CT due to its ready accessibility and newer scanners, reconstruction algorithms. And has decreasing scanning time and radiation dose. It can exclude the alternative intra-abdominal pathology like diverticulitis (Patel *et al.*, 2013).

Figure 1: Hi speed dual CT scanning machine

MATERIALS AND METHODS

This study was a hospital-based case-control study. Patients with cholecystitis and cholelithiasis of age between 17-80 years irrespective of gender were included in the study (cases). All patient's cases (100) and controls (100) were advised the night before that did not eat or drink. Control groups (Normal Gallbladder) were collected when patients are comprised of other abdominal disease diagnosed by computed tomography. GB wall thickness was measured in fasting. A total 200 samples of the gallbladder are collected from Department of Radiology, Santosh Medical College and Hospital, deemed to be University, Ghaziabad, Uttar Pradesh Delhi-NCR and Govt. medical college Saharanpur, Uttar Pradesh, India, after ethical clearance and taking consent from the patent, in this 100 cases and 100 controls were included in the study.

Gallbladder wall thickness measurement

Contrast-enhanced CT examinations of all individuals were performed with a 16-detector row of CT scanner Figure 1. CT scans were taken routinely during full inspiration when the patient in a supine position. In the late arterial phase, single-breath hold scans were obtained from the dome of the diaphragm to the pubis symphysis. The Transverse diameter and longitudinal axis were reviewed in each CT. The gallbladder wall thickness was measured at its most thickened portion.

Statistical analysis

The results were presented in frequencies, percentages and mean±SD. The Chi-square test used to find the associations of categorical variables between cases and controls. The Unpaired t-test used to compare gallbladder wall thickness between cases and controls. The receiving operating curve (ROC) analysis was carried out. The 95% confidence interval (CI) was the calculated area under the curve (AUC). The positive predictive value (PPV), and negative predictive value (NPV), sensitivity, specificity with its 95% CI was calculated. The p-value<0.05 was considered significant. All the analysis was carried out with the help of on SPSS 16.0 version (Chicago, Inc., USA).

RESULTS

One-fourth of cases (25%) and 40% of controls were >50 years of age studied by computed tomography. The mean age of controls and cases was 47.24±11.57 and 45.20±16.22 years, respectively studied by computed tomography.

There was no difference significant (p>0.05) in age between the groups showing comparability of the groups in terms of age studied by computed tomography. More than half of cases (62%) and 50% of controls were females studied by computed tomography. There was no difference significant (p>0.05) in gender between the groups showing comparability of the groups in terms of gender Table 1.

The transverse diameter was significantly

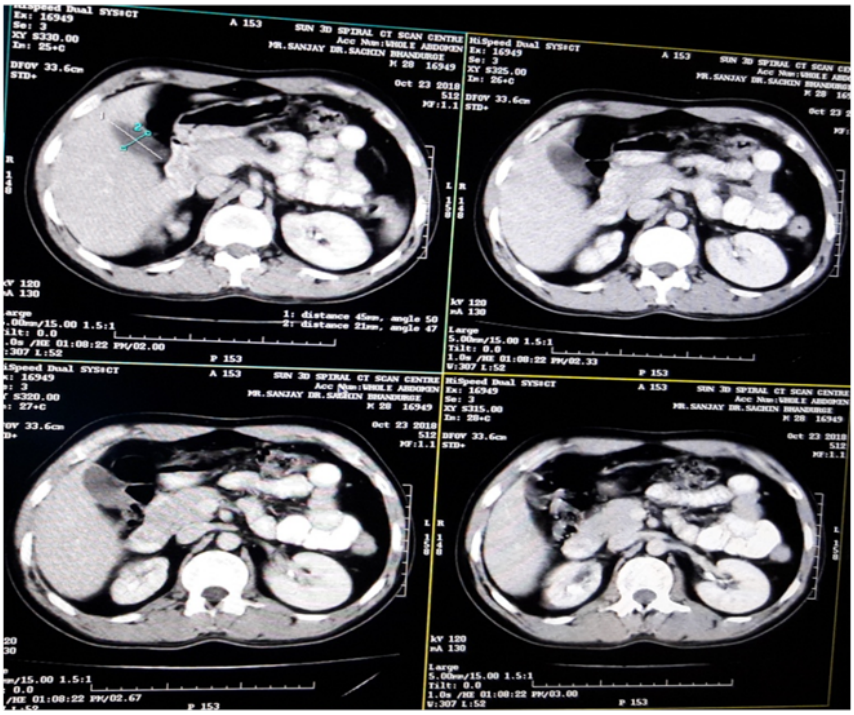

Figure 2: CT Scene of abdomen measuring longitudinal axis (Number 1) and Transverse diameter (Number 2) of gallbladder

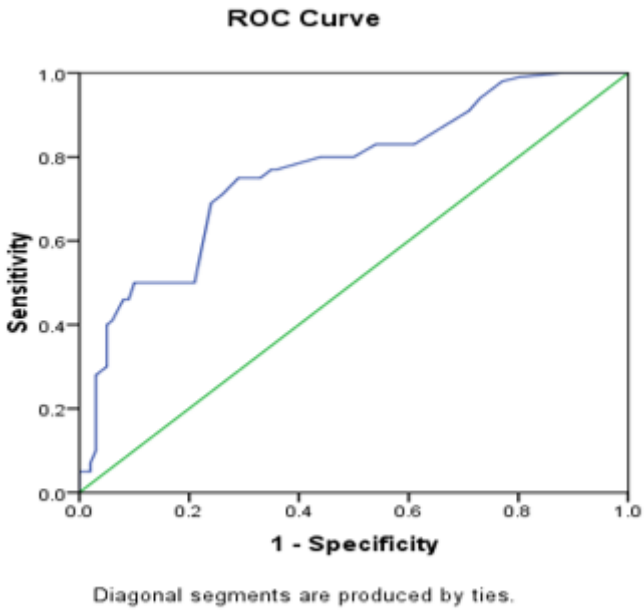

Figure 3: ROC curve showing the sensitivity and the specificity of transeverse diameter in predicting Cholecystitis and cholelithiasis by Computed tomography

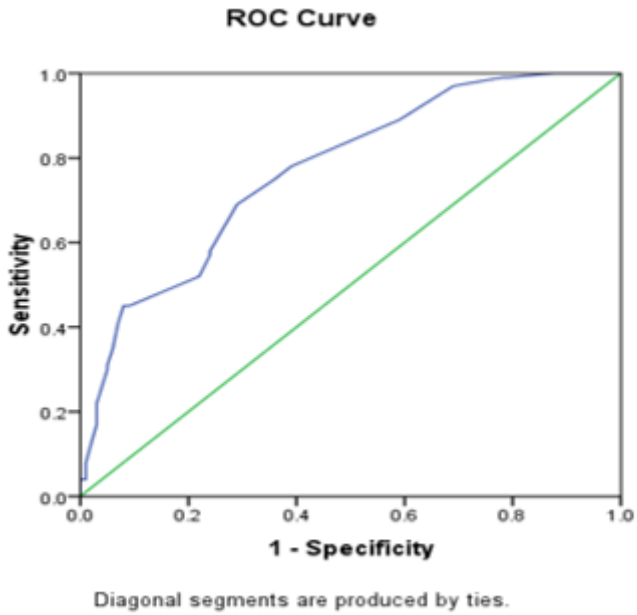

Figure 4: ROC curve showing the sensitivity and the specificity of longitudinal axis in predicting Cholecystitis and cholelithiasis by Computed tomography

Table 1: Distribution of demographic profile of patient's campared to the cases and controls

Demographic profile	Cases (n=100)		Control (n=100)		p-value[1]
	No.	%	No.	%	
Age in years					
<30	26	26.0	22	22.0	0.11
30-40	21	21.0	20	20.0	
41-50	28	28.0	18	18.0	
>50	25	25.0	40	40.0	
Mean±SD	47.24±11.57		45.20±16.22		
Gender					
Male	38	38.0	50	50.0	0.08
Female	62	62.0	50	50.0	

[1]Chi-square test

Table 2: Comparison of Transverse diameter and longitudinal axis in cases and controls studied by CT scan

Groups	Cases (n=100)	Controls (n=100)	p-value[1]
Transverse diameter (mm)	36.42±15.52	24.12±9.11	0.0001*
Longitudinal axis (mm)	33.23±14.73	21.75±8.69	0.0001*

[1]Unpairedt-test, *Significant

Table 3: Predictive value of transeverse diameter in predicting Cholecystitis and cholelithiasis by Computed tomography

Transverse diameter cutoff	CT cases		CT controls		Total	
	No.	%	No.	%	No.	%
>25	77	38.5	35	17.5	112	56.0
≤25	23	11.5	65	32.5	88	44.0
Total	100	50.0	100	50.0	200	100.0
Predictive values, % (95%CI)						
Sensitivity	77.0 (68.8-85.2)					
Specificity	65.0 (55.7-74.3)					
PPV	68.8 (60.2-77.3)					
NPV	73.9 (64.7-83.0)					
AUC	0.76 (0.70-0.83)					

[1]Chi-square test, PPV-Positive predictive value, PPV-Negative predictive value, AUC-Area under the curve, CI-Confidence interval, % ages are from total cases

Table 4: Predictive value of longitudinal axis in predicting Cholecystitis and cholelithiasis by Computed tomography

Longitudinal axis cutoff	CT cases		CT controls		Total	
	No.	%	No.	%	No.	%
>25	69	34.5	29	14.5	98	49.0
≤25	31	15.5	71	35.5	102	51.0
Total	100	50.0	100	50.0	200	100.0
Predictive values, % (95%CI)						
Sensitivity	69.0 (59.9-78.1)					
Specificity	71.0 (62.1-79.9)					
PPV	70.4 (61.4-79.4)					
NPV	69.6 (60.7-78.5)					
AUC	0.77 (0.70-0.83)					

[1]Chi-square test, PPV-Positive predictive value, PPV-Negative predictive value, AUC-Area under the curve, CI-Confidence interval, % ages are from total cases

(p=0.0001) higher among cases (36.42±15.52 mm) than controls (24.12±9.11 mm).

Longitudinal axis was significantly (p=0.0001) higher among cases (33.23±14.73 mm) than controls (21.75±8.69) Table 2 and Figure 2.

Transeverse diameter>25 correctly predicted cholecystitis and cholelithiasis by CT in 38.5% cases with the sensitivity and the specificity of 77% (95%CI=68.8-85.2) and 74% (95%CI=55.7-74.3%) respectively (Table 3 and Figure 3).

Longitudinal axis >25 correctly predicted cholecystitis and cholelithiasis by CT in 34.5% cases with the sensitivity and the specificity of 69% (95%CI=59.9-78.1) and 71% (95%CI=62.1-79.9%) respectively (Table 4 and Figure 4).

DISCUSSION

Typical CT findings of acute cholecystitis have been demonstrated as gallstones, GB distension, increased wall thickening, & wall enhancement, mural striation, fluid or pericholecystic stranding and increased hyperenhancement of the adjacent liver (Fidler *et al.*, 1996; Smith *et al.*, 2009; Shakespear *et al.*, 2010). In the present study, there was no significant (p>0.05) in age and sex between the groups. Thus both the groups were comparable. This study found that transverse diameter was significantly (p=0.0001) higher among cases (36.42±15.52 mm) than controls (24.12±9.11 mm) studied by computed tomography. Longitudinal axis was significantly (p=0.0001) higher among cases

(33.23±14.73 mm) than controls (21.75±8.69) studied by computed tomography. In a study of acute cholecystitis compared with the healthy population on helical CT, the most discriminating findings were mural stratification, pericholecystic fat stranding, hyperattenuating gallbladder wall, pericholecystic hypervascularity, short & long GB axis enlargement and GB wall thickening (Soyer *et al.*, 2013). In the present study, transverse diameter>25 correctly predicted cholecystitis and cholelithiasis by CT in 38.5% cases with the sensitivity and the specificity of 77% (95%CI=68.8-85.2) and 74% (95%CI=55.7-74.3%) respectively. Longitudinal axis >25 correctly predicted cholecystitis and cholelithiasis by CT in 34.5% cases with the sensitivity and the specificity of 69% (95%CI=59.9-78.1) and 71% (95%CI=62.1-79.9%) respectively. Yeo and Jung (2018) found that fluid collection or pericholecystic fat haziness and mural striation or increased wall thickening show moderate sensitivity and specificity. Yeo and Jung (2018) also reported that the cut-off value of transverse diameter in differentiating acute cholecystitis from chronic, acute cholecystitis was smaller.

This was consistent with an earlier study in which early acute cholecystitis showed <4 cm of the axial diameter (range between 3.0–4.3 cm; mean, 3.7 cm) in most cases (Kim *et al.*, 2009). Yeo and Jung (2018) observed that increased GB distension showed high sensitivity but low specificity. Increased GB size has been defined as the transverse diameter > 4 cm and longitudinal diameter > 8 cm based on previous studies (Altun *et al.*, 2007; Shakespear *et al.*, 2010).

CONCLUSION

In this study, increased transverse diameter and longitudinal axis were observed. Excellent sensitivity and the specificity of these two parameters was also found in predicting cholecystitis and cholelithiasis by computed tomography. CT scan has some distinct advantages over USG in detecting extension of the tumour and the involvement of surrounding structures, including hepatoduodenal ligament and lymph nodes. All such cases should be subjected to biopsy for histopathological examination to rule out the gallbladder carcinoma for better prognosis.

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The authors declare that they have no funding support for this study.

Conflicts Of Interest

The authors declare that they have no conflict of interest for this study.

Ethical Approval

The study was approved by the Institutional Ethics Committee.

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