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Gallbladder Wall Thickening: A Sonographic Evaluation

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Abstract
Gallbladder wall thickening is a common finding in sonographic evaluations, historically associated with primary gallbladder disease. However, it is now recognized as a non-specific sign indicative of both gallbladder and systemic diseases. Ultrasound is the preferred modality for initial evaluation due to its real-time imaging, cost-effectiveness and portability. This study was conducted at the Department of Radiology and Imaging, Gadag Institute of Medical Sciences, from November 2019 to April 2021. Participants included patients with abdominal pain, right upper quadrant tenderness, obstructive jaundice and suspected gallbladder diseases. Patients with non-right upper quadrant pain, acute abdomen from other causes, and post-cholecystectomy cases were excluded. Dual-probe ultrasound (8-5 MHz and 12-3 MHz) evaluated the gallbladder in sagittal and transverse planes, employing a subcostal oblique view for enhanced visualization. An 8-hour fasting protocol was mandatory to avoid pseudo-thickening. Evaluation criteria included wall thickness (>3.5 mm), echogenicity, margins, sonographic Murphy's sign, vascularity (Doppler) and posterior acoustic shadowing. The sample size was 504 cases, with maximum incidence in the 4th decade, followed by the 2nd and 3rd decades. Acute cholecystitis (165 cases) showed wall thickness >5 mm in 55%, pericholecystic fluid in 100%, and positive Murphy's sign in 77%. Chronic cholecystitis (18 cases) had wall thickness of 2-3 mm, with associated sludge in 22% and gallstones in 33%. Polyps (120 cases) presented with wall thickness of 3.5-10 mm, with associated gallstones in 18%. Emphysematous cholecystitis (4 cases) revealed the presence of gas within the wall. Gallbladder carcinoma (7 cases) demonstrated wall thickness >10 mm and infiltration into surrounding organs. Diffuse thickening from systemic diseases, such as cirrhosis, hepatitis and pancreatitis, was also observed. Gallbladder wall thickening has diverse etiologies, including primary gallbladder diseases and systemic conditions. Accurate diagnosis requires correlating sonographic findings with clinical and laboratory data to avoid unnecessary surgical interventions. This study underscores the importance of a comprehensive diagnostic approach to gallbladder wall thickening, enhancing the diagnostic acumen of clinicians and improving patient outcomes.

OPEN ACCESS

Key Words
Gallbladder wall thickening, sonography, ultrasound, gallbladder diseases, systemic conditions, acute cholecystitis, chronic cholecystitis, gallbladder carcinoma

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INTRODUCTION

Gallbladder wall thickening is a frequently encountered finding during sonographic evaluations. Initially, this thickening was considered a diagnostic indicator of primary gallbladder disease. However, over time, this concept has significantly evolved. It is now recognized that gallbladder wall thickening is a non-specific sign, which can be observed not only in various gallbladder diseases but also in several systemic conditions[1].

Sonography and computed tomography (CT) are both effective in assessing gallbladder wall thickness. Despite the capabilities of CT, ultrasound remains the preferred initial imaging modality for patients with clinically suspected gallbladder disease. The preference for ultrasound is due to its real-time imaging capabilities, speed, cost-effectiveness, and portability, making it an invaluable tool in the diagnostic process. Ultrasound's ability to provide immediate results at the point of care is particularly advantageous in acute clinical settings[2].

The gallbladder wall may thicken due to a wide range of causes. Primary gallbladder diseases such as cholecystitis, both acute and chronic, are common culprits. However, systemic conditions such as liver cirrhosis, heart failure, renal failure, and certain infections can also lead to gallbladder wall thickening. This variety in etiology underscores the importance of a thorough clinical evaluation and a comprehensive understanding of the patient's overall health status when interpreting sonographic findings[3].

In this study, we explore the various causes of gallbladder wall thickening and their diagnostic appearances on sonographic imaging. Understanding the diverse etiologies and the sonographic characteristics associated with gallbladder wall thickening is crucial for accurate diagnosis and appropriate management of patients presenting with this condition. The sonographic features that can help differentiate these causes include the presence of gallstones, pericholecystic fluid, changes in the liver, and other concurrent findings[4].

By delving into the different causes, this study aims to provide a comprehensive overview that can aid clinicians in distinguishing between primary gallbladder diseases and systemic conditions that manifest as gallbladder wall thickening. This knowledge is essential for improving diagnostic accuracy and ensuring that patients receive timely and effective treatment. Additionally, understanding the sonographic nuances can help in guiding further diagnostic workups, such as laboratory tests or additional imaging studies, to confirm the underlying cause of the gallbladder wall thickening[5-7].

Overall, this study highlights the significance of sonographic evaluation in detecting gallbladder wall thickening and underscores the importance of considering a broad differential diagnosis when this finding is encountered. The real-time imaging capabilities of ultrasound allow for dynamic assessment and immediate clinical correlation, enhancing its value in both emergency and routine clinical settings. Through this comprehensive exploration, we aim to contribute to the enhanced diagnostic acumen of clinicians and improved patient outcomes.

MATERIALS AND METHODS

Study Design and Setting: This study was conducted at the Department of Radiology and Imaging at Gadag Institute of Medical Sciences. The primary aim was to describe the diagnostic appearances of gallbladder wall thickness across a spectrum of diseases using transabdominal ultrasound. The study period spanned from November 2019-April 2021.

Participants:

Inclusion Criteria: Patients presenting with a history of abdominal pain, tenderness in the right upper quadrant, clinical features of obstructive jaundice, and those clinically diagnosed or suspected of having diseases affecting the gallbladder wall were included in the study. These patients were selected to ensure a focus on conditions directly impacting the gallbladder.

Exclusion Criteria: Patients presenting with abdominal pain located in areas other than the right upper quadrant, all cases of acute abdomen due to causes such as peptic ulcer, hollow viscus perforation, intestinal obstruction and all post-operative patients of cholecystectomy were excluded from the study. This exclusion was necessary to eliminate confounding factors that could obscure the specific sonographic findings related to gallbladder wall diseases.

Data Collection and Imaging Protocol: The evaluation of the gallbladder was performed in both sagittal and transverse planes using two different probes: one with low frequency (8-5 MHz) and one with high frequency (12-3 MHz). This dual-probe approach ensured optimal visualization of the gallbladder wall and surrounding structures. To avoid missing pathologies, a special maneuver was employed: the use of a subcostal oblique view with the left edge of the transducer positioned more cephalad than the right edge. This technique enhanced the visualization of the gallbladder and helped in identifying subtle abnormalities.

An attempt to elicit a sonological Murphy's sign (maximal abdominal tenderness from pressure of the ultrasound probe over the visualized gallbladder wall) was made to detect cholecystitis. This sign is a crucial diagnostic feature for identifying inflammation of the gallbladder.

Fasting Protocol: The upper limit for normality of the gallbladder wall thickness was set at 3.5 mm. To ensure accurate measurement, patients were required to undergo an 8-hour fasting period before the examination. Ingestion of food, particularly fatty food, stimulates the gallbladder wall to contract, which can cause the wall to appear thickened and potentially obscure luminal or wall abnormalities. Therefore, strict adherence to the fasting protocol was maintained to avoid such diagnostic pitfalls.

Ultrasound Evaluation Criteria: The following components of the gallbladder wall were meticulously studied and recorded during the ultrasound examination:

- **Thickness:** The measurement of the gallbladder wall thickness was a primary focus, with 3.5 mm set as the upper limit for normality.
- **Echogenicity:** The internal echo pattern of the gallbladder wall was assessed to identify any abnormalities.
- **Margins:** The smoothness or irregularity of the gallbladder wall margins was noted, as irregular margins can indicate pathological changes.
- Sonographic Murphy's Sign: The presence of this sign was recorded to aid in the diagnosis of cholecystitis.
- **Vascularity:** Doppler ultrasound was used to assess the vascularity of the gallbladder wall, which can indicate inflammation or other pathologies.
- **Posterior Acoustic Shadowing:** This feature was evaluated to identify the presence of gallstones or other calcifications within the gallbladder.

RESULTS AND DISCUSSIONS

Among 504 cases, gallbladder pathologies were seen in all age groups with maximum incidence seen in 4th decade followed by 2nd and 3rd decade respectively.

Review scan after 3 months gallbladder wall thickness returned to normal

Sonographic Anatomy: Gallbladder is a hollow pear shaped viscera with thin and regular wall. It is divided into infundibulum, body and fundus. The wall of gallbladder comprises of 4 layers, inner layer is mucosa, followed by 2nd layer of irregular muscular tissue, 3rd and 4th layers constitute loose connective tissue and serosa respectively.

The normal volume of gallbladder is 30-50 ml.

The wall has layered appearance on sonography, by means of ultrasound it is possible to identify three layers: the innermost, corresponding to the mucosa, that is linear, echogenic and presents a regular surface, the second one, corresponding to the muscular layer, is thin and slightly hypoechoic and outermost layer corresponding to the organ's serosa, that is linear, echogenic and regular 1-2 (FIG 1).

The normal gallbladder wall is seen as pencil thin echogenic line on sonography. The normal gallbladder wall can be seen on CT as thin soft tissue density structure which enhances on administration of intravenous contrast.

Most of the authors consider 3 mm gallbladder wall thickness as upper limit of normality. However pseudo thickening have been observed with inadequate fasting. Hence when gallbladder wall thickening needs sonographic evaluation, 8hrs fasting before examination is recommended, which was followed in our study.

Spectrum of Diseases Involving Gall Bladder Wall Can be Classified Into:

- Primary gallbladder wall pathologies viz, acute cholecystitis, chronic cholecystitis, acalculous cholecystitis, porcelain gallbladder, xanthogranulomatous cholecystitis.
- Secondary gallbladder wall involvement with primary gallbladder pathologies viz, gallbladder carcinoma, adenomyomatosis.
- Secondary gallbladder wall involvement with systemic diseases viz, liver cirrhosis, congestive heart failure, hepatitis, pancreatitis.

Gallbladder wall thickening is classified as localized and diffuse. It is further graded as mild (between 4 and 7 mm), marked (> 7 mm).

Diffuse Gallbladder wall Thickening: Diffuse gallbladder wall thickening is seen in a variety of conditions. It may be due to gallbladder pathology or due to secondary involvement in extrinsic pathological conditions, such as cirrhosis, hepatitis, congestive right heart failure, renal failure and pancreatitis. In cases of secondary involvement, the gallbladder wall returns to normal after correction of extrinsic cause.

In our study we have come across 150 cases of secondary wall involvement due to cirrhosis, pancreatitis and hepatitis[3]. The wall thickness returned to normal after treatment.

Liver Disease: gall bladder wall thickening is noted in acute and chronic liver diseases. Acute hepatitis with sonographic findings of diffuse thickened gall bladder wall with edema is a frequent finding. In chronic liver disease, liver failure with portal hypertension gall bladder wall thickening with impaired contractility is seen. The thickness of gall bladder wall depends upon the degree of distension. Pseudo thickening can be seen in post-prandial state due to physiologic contraction.

When there is gall bladder wall thickening with absence of gall stones, pericholecystic fluid & positive murphy's sign, with presence of liver disease, possibility of liver disease as a cause for gall bladder wall thickening is considered.

In renal or cardiac failure gall bladder wall thickening is seen. Possible mechanism in elevated portal venous pressure, low intra vascular osmotic pressure, or combination of both. The gall bladder wall is grossly thickened (>10mm) in liver and systemic diseases, with associated absence of gall bladder distension.

In pancreatitis gall bladder wall is thickened due to spread of inflammation or rarely due to immunological reaction.

In our series we have observed that in evaluation of systemic disorders, the key sonographic finding is normal mucosal regularity and echogenicity i.e. of the first layer. The wall thickness occurs mainly at the muscular layer and conjunctive layer. It is seen as hypoechoic layer due to edema, which was seen in all our cases. Similar findings were observed by other authors[4].

Cholecystitis: Acute cholecystitis; occurs mostly due to obstruction of cystic duct or gall bladder neck obstruction, secondary to cholelithiasis. It is the most frequent inflammatory condition of gallbladder Sonographic murphy's sign in combination with cholelithiasis are highly-suggestive of acute cholecystitis. The gall bladder wall thickening and pericholecystic fluid are considered as secondary signs. Mural thickening of gall bladder wall can occur

Fig 1: Normal gallbladder wall with 3 layers
Case 1: Acute Cholecystitis

Fig 2: USG image showing thickening of gall bladder wall with mural edema and mild pericholecystic fluid
Case 2: Calculus Cholecystitis

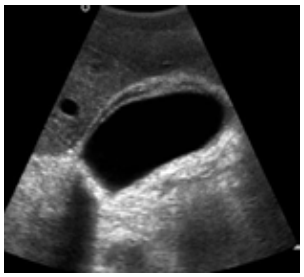

Fig 3: USG image showing gall bladder wall thickening with echogenic focus within lumen
Case 3: Multiple gall bladder polyps

Fig 4: USG image showing multiple well defined echogenic foci adherent to wall
Case 4: Adenomyomatosis

Fig 5: USG image showing well defined hyperechoic focus with comet tail artefact
Case 5: Gangrenous cholecystitis

Fig 6: USG image showing well detached membranes within lumen and asymmetrical wall thickness
Case 6: Gall Bladder Malignancy

FIG 7: USG image showing ill defined mass lesion nearly obscuring the lumen of gall bladder

Table 1: Distribution Of Cases According To Various Etiologies Of Gallbladder Wall Thickness With Associated Parameters

Etiology	Acute Cholecystitis	Chronic Cholecystitis	Acalculous Cholecystitis	Emphysematous Cholecystitis	Polyps	Adenomyomatosis	Gangrenous Cholecystitis	Carcinoma
No. Of Cases	165	18	4	4	120	32	4	7
Wall Thickness In Mm	3.5 – 5 Mm (45 %)							
>5mm (55%)	2-3 Mm	3.5-8 Mm	3.5-5 Mm	3.5-10 Mm	3.5-7 Mm	3.5-7 Mm	>10 Mm	
Gall Bladder Distension								
(>8 Cm Longitudinally)	150	-	3	2	-	-	-	5
Associated Sludge	33(20 %)	4 (22%)	3	-	58	3	-	-
Associated Gall Stones	86(52 %)	6 (33%)	-	1	22	8	-	3
Murphy's Sign	127(77 %)	-	4	4	-	-	-	-
Pericholecystitic Fluid	165 (100%)	2 (11%)	3	3	-	-	2	-
Infiltration Into Surrounding Organs	6	-	-	-	-	-	-	-
Reverberation Artefacts	-	-	-	-	-	32	-	-
Vascularity On Color Doppler	165 (100%)	2 (11%)	3	3	66	-	2	7

Table 2: Diffuse Gallbladder Wall Thickening Due To Systemic Diseases

Disease	Total	Mucosa	Gb Stones	Pericholecystic Fluid	Positive Murphy's Sign
Cirrhosis	65	Regular With Normal Echogenicity	9	49(75%)	16
Hepatitis	26	Regular With Normal Echogenicity	4	7(25%)	8
Pancreatitis	59	Regular With Normal Echogenicity	12	47(80%)	35

secondary to edema and is seen as a sonolucent line between the echogenic lines in gall bladder wall. On ultrasound gall bladder distension (width >4cm) is an important finding, in its absence diagnosis of acute cholecystitis is not considered. In all our cases of acute cholecystitis, the average distension of gallbladder was about 5-6 cms.

In our series we have encountered 165 cases of acute cholecystitis, 86 of them presented with cholelithiasis and 127 with positive Murphy's sign. In all 165 cases we have noted pericholecystic fluid. All the cases showed gallbladder wall thickness in the range of 3.5-5 mm in 45% and > 5mm in 55% of cases (FIG 2).
In pregnancy due to higher levels of estrogen, there is increased cholesterol in bile and also there is cholestasis due reduced contractions resulting in gall stones and subsequently cholecystitis.

In our study, wall thickness of gallbladder more than 3 mm is taken as cut-off value for acute cholecystitis.

Deitch and Engel J M. reported thickening of the gallbladder wall as the most reliable criterion with reported specificity of 90% using 3.0 mm and 98.5% at a 3.5 mm wall thickness, whereas sensitivity was 100% at 3.0 mm but only 80% at 3.5 mm, they recommended acceptance of gallbladder wall thickness of 3.5 mm or greater as definitive evidence of acute cholecystitis, whereas 3.0 mm is suggestive but not conclusive evidence[5].

In our series, sonographic Murphy's sign and pericholecystic fluid were found to be reliable indicators. In a study done by Vriesman AC *et al,* In 2007, Accuracy in diagnosing acute cholecystitis increased when using a combination of findings including cholelithiasis, gallbladder wall thickening and a positive sonographic Murphy's sign[6].

Gallbladder sludge is usually present in addition to other features of acute cholecystitis. However as patients are sick other findings secondary to systemic diseases may be seen. In our study, 33 cases of acute cholecystitis were associated with echogenic sludge (20 %).

Biliary tract viral infections are characterized by acute cholecystitis-an acute inflammation of the gall bladder wall and cholangitis-an inflammation of the bile ducts[15].

Acute acalculous cholecystitis is rare as the first manifestation of systemic lupus erythematosus and it usually has a poor prognosis when not associated with connective tissue disease. An abdominal ultrasound with features of gallbladder wall thickening and pericholecystic fluid are consistent with acute acalculous cholecystitis[16].

JL Huffman *et al.* stated that ultrasound has been touted as the modality of first choice to evaluate suspected acute cholecystitis because it lends itself to rapidity, repeatability, and portability[7].

Chronic cholecystitis is a clinically used terminology when gallbladder stones are symptomatic tending to transient obstruction. It further causes low grade inflammation with fibrosis.

Clinical history plus gallbladder wall thickening & gallbladder calculus are the essential conditions for the diagnosis of chronic cholecystitis.

Chronic cholecystitis is usually always associated with calculous disease, ultrasound shows lucency of gallbladder wall, and distended gall bladder with sludge. Pericholecystic fluid is not seen. Fibrotic changes in the wall may lead to contracted gall bladder.

In many cases precipitating factor is the extravasation of bile into gallbladder wall, Ex. is Rokitansky-Aschoff sinuses. The ultrasound findings are non-specific and may show thickened gallbladder wall and calculi, it has to be differentiated from carcinoma gallbladder.

In our study 18 cases of chronic cholecystitis were associated with previous recurrent episodes of acute cholecystitis which were subsided for a period of time after treatment. In all these cases there was positive history, with gallbladder calculus and gallbladder wall thickening.

CT can also reveal gall bladder wall thickness, distension, calculi, mucosal hyper enhancement, we

can also visualize pericholecystic fluid, inflammatory fat stranding. It is important to remember that 20% of gall bladder stones are isodense to bile and hence missed on CT.

Yun EJ *et al.* reported the most commonly observed imaging findings in the setting of chronic cholecystitis are cholelithiasis and gallbladder wall thickening. The gallbladder may appear contracted or distended, and pericholecystic inflammation is usually absent[8].

Gangrenous cholecystitis; It is one the most common complication of acute cholecystitis(15%). It occurs as a result of ischaemia leading to necrosis of gallbladder wall. On ultrasound following features suggest gangrenous cholecystitis, intra luminal membranes, asymmetric wall thickening and focal perfusion defects on Doppler.

Sharlene A. Teefey *et al.* Gangrenous Cholecystitis: New Observations on Sonography, studied on 25 patients with gangrenous cholecystitis and observed a new sonographic finding- striated thickening of the gallbladder wall- and three patterns of pericholecystic fluid collections. Heterogeneous thickening of the gallbladder wall was characterized by either multiple striations (alternating hypoechoic and hyperechoic layers) or irregular mass·like protrusions projecting into the gallbladder lumen[9].

We have encountered 4 cases of gangrenous cholecystitis where diagnosis was confirmed by, irregular gallbladder mucosal outline, gallbladder wall thickening with gas within, absence of calculi, large pericholecystic collection (FIG 6).

Emphysematous Cholecystitis: is a severe form of acute cholecystitis. We have come across a single case of emphysematous cholecystitis in a diabetic patient, murphy's sign was positive and thickened gallbladder wall demonstrated highly echogenic reflectors with low level posterior acoustic shadowing and reverberation artefacts, suggesting presence of gas in the wall.

K. Konno *et al.* Emphysematous cholecystitis: sonographic findings, reviewed ultrasound findings of 11 surgically proven cases of emphysematous cholecystitis, in cases with small amounts of gas, ultrasound showed an echogenic line with a distinct ring-down artifact or a powder snow-like speckled posterior echo. In cases with large amounts of gas, ultrasound showed a wide spiculated echogenic band with a powder snow-like speckled posterior echo or a speckled acoustic shadowing. In all cases, the presence of gas prevented visualization of the gallbladder wall. Ultrasound did not differentiate gas localized to the gallbladder wall and gas extending to the surrounding hepatic tissue[10].

We have come across 4 cases with similar findings confirming the diagnosis.

Acalculous Cholecystitis: this condition occurs due to gradual, increase in viscosity of bile ultimately leading to functional obstruction of cystic duct with stasis of bile.

Shetty PB , Broome DR. Gallbladder sonographic findings associated with Salmonella typhi enteric fever. Sixty-two patients with culture positive Salmonella enteric fever were analyzed with serial sonography. The following gallbladder sonographic findings were noted: globular gallbladder distention (33 of 62 patients, 53%), positive sonographic Murphy sign (25 patients, 40%), pericholecystic edema or fluid (25 patients, 40%), gallbladder wall thickening > 4 mm (21 patients, 34%), low-level non shadowing intra luminal echoes or sludge (nine patients, 15%), intramural linear sonolucency or striation (eight patients, 13%), and mucosal irregularity or sloughed membrane (four patients, 6%).

It is common in hospital patients after surgery or trauma. Ultrasound features include gall bladder wall thickening, pericholecystic fluid, intramural gas, sloughed mucosa, sludge and hydropic gall bladder.
We have come across 4 cases with similar findings confirming the diagnosis.

Gallbladder Carcinoma: is one of the commonest gastrointestinal tract malignancy. It is usually detected late due to lack of specific symptoms.

Imaging appearances are varied, it can present as polypoid intra luminal lesion or infiltrating mass replacing gallbladder or diffuse mural thickening.

The most common presentation on sonography is a diffusely infiltrating lesion which replaces gallbladder and it extends into liver. Rarely it can also present as asymmetric mural thickening or intra luminal mass. Gallbladder stones are seen associated in 80% of cases. Extensive gallbladder wall thickening (>10 mm) along with mural irregularity, marked asymmetry should suggest possibility of malignancy. Additional sonographic features will be invasion of adjacent structures, bile duct dilatation, metastases in liver or lymph nodes.

In our series we have encountered 7 cases of gallbladder carcinoma where the gallbladder wall thickening was more than 10 mm. Other features were presence of a gallbladder stone, distension of gallbladder lumen with intra luminal mass and infiltration into adjacent liver.

Randi G *et al,* reported mass Occupying or replacing the Gallbladder lumen, was seen in 40-65% of patients with gallbladder carcinoma at initial detection. According to him on ultrasound the presence of a large gallbladder mass that replaces the lumen, directly invading the surrounding liver parenchyma is highly suggestive of gallbladder carcinoma.

Role of Colour Doppler in Acute Cholecystitis: Initially it was thought that the presence of arterial flow in the thickened gallbladder wall is non specific and of limited value in the diagnosis of cholecystitis[11].

However it was later observed that colour velocity imaging and power Doppler sonographic imaging is very useful in doubtful cases at acute cholecystitis. Enlarged arteries and increased venous filling are seen historically in acute cholecystitis. This can explain the improved sensitivity for detecting acute cholecystitis compared with gray scale sonography[12].

In our series all the cases of acute cholecystitis revealed increased flow.

Focal Pattern: Focal gallbladder wall thickening (>3mm) can be due to neoplastic and non-neoplastic etiology.

Adenomatous polyp, gallbladder carcinoma and metastases are neoplastic causes, where as cholesterol or inflammatory polyps, focal adenomyomatosis and xanthogranulomatous cholecystitis are non neoplastic etiological factors.

Adenomatous Polyps: They are seen to grow as pedunculated masses into the lumen of gallbladder. They are considered by some authors as pre malignant. Sonographically we can see non-mobile, non shadowing polypoid intra luminal masses. Size is an important criteria, as polyps smaller than 5 mm are usually benign and between 5 mm to 10 mm need follow up every 4-6 months, for observing malignant changes.

We have come across 120 cases of polyps in our series. Out of these 37 cases were of cholesterol polyp and remaining 83 were adenomatous in type.

In our study among 120 cases of GB polyps, 95 cases were between 3-4 mm, 5 cases each in 1-2 mm and 5-6 mm, remaining 5 cases were of 10 mm or greater. Polyps of more than 10 mm were considered to be with increased risk of malignancy in older age group (>60 yrs) and were followed up with subsequent scans for increase in size, which was not seen at 6 month follow up (FIG 4).

In a similar study by Michael T. Corwin *et al*. studied on 346 patients with mean age 52 yrs (20-93 years) and found that risk of malignancy is more in polyps of 1 cm or more diameter, single polyp, sessile polyps, polyps with adjoining increased wall thickness and also with increasing age. When two or more polyps were recognized and increase in size of 0.2 cm or more on follow-up study, was of significance. They were distinguished as stable, resolved, increased/reduced in size on the basis of the highest length measurement[13].

Cholesterol polyps appear on ultrasound as echogenic structures with comet tail reverberation artefacts.

Adenomyomatosis: It is an acquired hyper plastic process with proliferation of epithelium. There are deep invalidations extending into muscular layer of gallbladder wall. This process may be focal, segmental or diffuse. Ultrasound findings are characterized by mural thickening with echogenic foci having comet tail artefact. They represent cholesterol crystals in the lumen of Rokitansky-Aschoff sinuses.

In our series we have observed 32 cases of adenomyomatosis. All the patients were females having gallbladder calculi. In our patients gallbladder was distended but there was absence of murphy's sign and pericholecystic fluid. The diagnostic feature was multiple echogenic intramural foci, which caused reverberation artefacts (FIG 5).

In adenomyomatosis we get muscular hypertrophy and intramural diverticula (Rokitansky-Aschoff sinuses) which will involve gallbladder wall diffusely or segmentally.

Sonographically presence of cholesterol crystals seen as comet tail reverberation artefacts within the thickened gallbladder wall is highly suggestive of this condition. All 32 cases in our series had these features. This condition has to be differentiated from emphysematous cholecystitis, where air will produce similar artefacts. The patients of emphysematous cholecystitis are very sick as compared to that of adenomyomatosis.

Focal adenomyomatosis; focal form commonly involves the fundus of gallbladder. On ultrasound echogenic intramural foci with comet tail reverberation artifact is diagnostic. On colour Doppler twinkling artifact is useful to confirm the diagnosis.

In 2006 Boscak AR *et al*, Echogenic intramural foci from which emanate V shaped comet tail reverberation artefacts representing the unique acoustic signature of cholesterol crystals within the lumen of Rokitansky-Aschoff sinuses, are highly specific for adenomyomatosis[14].

Gallbladder Carcinoma: can also present as focal wall thickening which is irregular, colour Doppler can reveal flow within the mass and differentiate it from tumefactive sludge. As with diffuse from the tumor invade adjacent liver and biliary tree (FIG 8).

Metastases: involving gallbladder wall is a rare entity. It is usually noted in melanoma. Rarely it can occur in renal or pulmonary malignancy. We have not come across any case of gallbladder wall metastasis.

CONCLUSION

There is a wide range of differential diagnosis for gallbladder wall thickening. To begin with it is better to differentiate between focal and diffuse forms, later on identification of additional imaging features allow us to make accurate diagnosis. Gallbladder wall thickness is

no more synonymous for acute cholecystitis. The correlation with other sonographic features, clinical & laboratory findings are of great importance so that unnecessary surgical interference can be avoided.

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