ORIGINAL ARTICLE

# TRANSABDOMINAL ULTRASOUND: A POTENTIALLY ACCURATE AND USEFUL TOOL FOR DETECTION OF CHOLEDOCHOLITHIASIS

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**Background:** Choledocholithiasis denotes to the presence of gallstones within the common bile duct. In patients with Gall stones, the precise incidence and prevalence of choledocholithiasis are not known, but it has been estimated that 5–20 percent of patients have choledocholithiasis at the time of cholecystectomy, with the incidence increasing with age. The transabdominal ultrasound examination (US) is the most commonly used modality for symptoms attributable to gallstone disease. US can provide important evidence for presence of stones in CBD. **Methods:** This was a descriptive cross-sectional validation study which was conducted at PAEC General Hospital, Islamabad from February to July 2015. Patients with suspected choledocholithiasis attending radiology department for ultrasound abdomen were included in the study. Findings for dilatation of common bile duct, intrahepatic biliary channel dilatation and direct visualization of calculus in CBD were noted. Ultrasound findings were compared with subsequent ERCP which was considered gold standard. **Results:** Diagnostic accuracy of trans abdominal ultrasound in detection of choledocholithiasis came out to be 76.9% with sensitivity of 76.2% and specificity of 81.3%. **Conclusion:** Ultrasound can be used as an initial and baseline tool for detection of CBD calculi as it is non-invasive, easily available, radiation free and cost effective.

**Keywords:** Choledocholithiasis; Trans abdominal ultrasound; Endoscopic retrograde cholangiopancreatography; Diagnostic accuracy

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## INTRODUCTION

Biliary ductal calculi are found in 15–17% of patients with symptomatic gall stones. Endoscopic retrograde cholangio-pancreatography (ERCP) with sphincterotomy and removal of stones is the current standard of care.[1]

Small stones in the gallbladder fall into the common bile duct (CBD) on their way to the duodenum. Sixty to 80% of patients with CBD stones are asymptomatic.[2] By far the most common cause of biliary obstruction is choledocholithiasis.[3]

When suspecting choledocholithiasis, the initial investigation of choice is ultrasound abdomen because of its non-invasive, easy availability, radiation free and cost-effective nature.[3]

Transabdominal ultrasound has a sensitivity of 82% and a specificity of 98% in the diagnosis of CBD calculi.[4]

Endoscopic retrograde cholangio pancreatography (ERCP) is considered one of the gold standards in the diagnosis and treatment of bile duct stones. ERCP is an invasive investigation and carries a potential complication rate of 3–6%. However, it carries the advantage of performing sphincterotomy and basket or balloon extraction of bile duct stones. The sensitivity and specificity of ERCP in detecting choledocholithiasis is 93% and 100%, respectively.[5]

Silent choledocholithiasis diagnosed preoperatively need to be managed by ERCP and duct clearance before surgery however if it is found post operatively, it is reasonable to manage silent choledocholithiasis expectantly in the short-term post operatively.

There are many risk factors for having gall bladder disease however it progresses more rapidly in patients with diabetes, who tend to have worse infections.[6]

Choledocholithiasis is a major risk in patients having cholelithiasis, and carries high risk of morbidity and mortality. It can be diagnosed with ERCP but it is expensive, invasive, involves radiation and is not readily available. Transabdominal ultrasound can detect CBD stones with much accuracy, it has the benefit of finding calculi in addition to looking for biliary tract and pancreas, and it is inexpensive, non-invasive, radiation free and is readily available. The purpose of study was that if the accuracy of transabdominal ultrasound comes out to be high, we can rely on this easily available investigation for detection of CBD calculi and subsequent ERCP can be done to remove stones so that ERCP can be reserved for therapeutic purpose only. No local or international study has been done in recent five years on transabdominal ultrasound for detection of CBD stones.

## MATERIAL AND METHODS

It was a descriptive cross-sectional validation study conducted at PAEC General Hospital, Department of Radiology and Department of Endoscopy/ERCP. Sample size was calculated using WHO sample size calculator taking sensitivity as 82% and specificity as 98%[4], prevalence of choledocholithiasis as 17%[1] and desired precision for sensitivity 10% and for specificity 2% and confidence level 95%. Sample size was 234. The duration of the study was six months from February to July 2015. Sampling technique used was non-probability (Consecutive) sampling. A patient was labelled as having choledocholithiasis if he was found to have, Direct visualization of calculus in CBD, Dilated extra and intrahepatic biliary channels (>2 mm).

Dilated CBD (diameter >8 mm for age ≤75 years and diameter >10 mm for age >75 years) on ultrasonography. A patient was labelled as having choledocholithiasis if there was direct visualization of calculus in CBD on diagnostic ERCP.

All adult patients (mean age 20–60 years), presenting with, pain RHQ where biliary cause was suspected, obstructive jaundice (clinical plus lab findings), dark coloured urine, clay coloured stool and raised alkaline phosphatase (40–100 IU/L) were included. Whereas those who already have undergone cholecystectomy and patients with significant comorbidities who are not candidates for ERCP were excluded.

The data was collected with the help of proforma. Toshiba ultrasound machine attached to 3.5MHz curvilinear transducer with colour and pulsed Doppler capability was used. Patients were examined in the supine and left lateral position.

Statistical analysis was performed using SPSS version 10. Mean with standard deviation was calculated for quantitative variables. Frequency and percentages were calculated for qualitative variables. A 2×2 cross table was constructed to calculate sensitivity, specificity, PPV, NPV, and diagnostic accuracy of both imaging modalities.

## RESULTS

A total of 234 patients (both genders, males and females) were included in this study. One hundred & sixty-four (70.1%) were females and 70 (29.9%) were males. Mean age of patients was 51.6±17.2 years.

The positive cases of choledocholithiasis on USG and ERCP were analysed. 160 (68.3%) out of 234 study cases had CBD stones on ultrasound while 202 (86.3%) had choledocholithiasis on ERCP. The distribution of true positive, false positive, true negative and false negative cases was measured. 65.8% were true positive cases, 2.5% were false positive, 20.5% were false negative and 11.1% were true negative cases.

Diagnostic accuracy of transabdominal ultrasound in detection of choledocholithiasis came out to be 76.9% with sensitivity of 76.2% and specificity of 81.3%. While the positive and negative predictive values were 96.3% and 35.1% respectively. (Table-1)

The other predictive factors or indirect signs of choledocholithiasis were also calculated, out of which dilatation of CBD was most reliable and was present in almost all of the patients which was later confirmed by ERCP. Intrahepatic biliary channel dilatation was seen in few patients with long standing CBD obstruction.

**Table-1: Age of study patients (n=234)**

| | No of patients | %age |
|---|---|---|
| **Age in years** | | |
| 10–20 | 4 | 1.7 |
| 21–30 | 30 | 12.8 |
| 31–40 | 34 | 14.5 |
| 41–50 | 48 | 20.5 |
| 51–60 | 48 | 20.5 |
| 61–70 | 36 | 15.4 |
| 71–80 | 20 | 8.4 |
| 81–90 | 14 | 6.0 |
| **Mean age** | 51.6±17.2 | |

**Table-2: Gender of study patients (n = 234)**

| | No of patients | %age |
|---|---|---|
| **Gender** | | |
| Male | 70 | 29.9 |
| Female | 164 | 70.1 |

**Table-3: Positive cases of choledocholithiasis according to USG and ERCP (n=234)**

| | No of patients | %age |
|---|---|---|
| Ultrasonography | 160 | 68.3 |
| ERCP | 202 | 86.3 |

**Table-4: Diagnostic accuracy of USG (n=234)**

| Validation Parameter | %age |
|---|---|
| Sensitivity | 76.2 |
| Specificity | 81.3 |
| PPV | 96.3 |
| NPV | 35.1 |
| Diagnostic accuracy | 76.9 |

## DISCUSSION

Choledocholithiasis can be seen in per op cholecystectomy patients in up to 3–10%, or as high as 14.7% in some series.[7,8] This also includes that patient who does not have classic preoperative findings of choledocholithiasis. Of these asymptomatic patients, about 15% will become symptomatic at some stage [9] and require further interventional treatment.

Cholesterol gallstones account for 80–95% of the gallstones found during cholecystectomy [10,11]

CBD stones can be detected before, during or after cholecystectomy. The standard preoperative workup for cholelithiasis includes liver function tests[12], and abdominal ultrasound. Reports may suggest the presence of cholelithiasis and choledocholithiasis.[9] On transabdominal ultrasound there can be direct visualization of calculus in CBD or there can be indirect signs of choledocholithiasis like dilated common bile duct and intra or extrahepatic biliary channel dilatation.

A preoperative assessment tool for choledocholithiasis includes magnetic resonance cholangio-pancreatography (MRCP) and endoscopic retrograde cholangio-pancreatography (ERCP), as a complement to routine laboratory and imaging studies. ERCP not only confirms the presence of calculi in CBD and biliary channel dilatation, it can also be used for therapeutic purposes, for extraction of calculi and treatment of choledocholithiasis. Simultaneously endoscopic sphincterotomy can be done and subsequent CBD stones can pass into duodenum without obstructing CBD.

A total of 234 patients (genders, males and females) coming to Radiology department of PAEC General Hospital, Islamabad with provisional diagnosis of choledocholithiasis were included in the study. The mean age of patients was 51.6±17.2 years. A study conducted by Prachayakul *et al*[10] showed the mean (±SD) age of the patients was 61.0 (±15.6) years (range, 26–85 years). This is because symptomatic cholelithiasis and subsequent choledocholithiasis incidence is rare in younger age groups. In the older population CBD is itself dilated so we rely more on direct visualization of calculus in CBD than the indirect signs of choledocholithiasis.

In our study female gender was predominant with 70.1% proportion while 29.9% patients were males. Prachayakul *et al*[10] showed 50.5% were males in their study. In our setup female patients are more prone to develop cholelithiasis and its subsequent complications as they carry most of the risk factors for development of gall stones.

The role of transabdominal ultrasound in detection of choledocholithiasis has been studied in our study. The important features that can help us in reaching diagnosis of choledocholithiasis are dilated CBD, direct visualization of calculus and dilated intrahepatic biliary channels. The first radiological sign which appears on ultrasound is dilatation of CBD which was present in almost all of patients with CBD calculus in our study.

The sensitivity and specificity of transabdominal ultrasound in direct visualization of calculus in our study came out to be 76.2% and 81.3% respectively. Our results were corresponding with previous studies where they found out sensitivity of transabdominal ultrasound in detecting choledocholithiasis as 82% and specificity 98%.13

Stott M *et al* found out the sensitivity and specificity of ultrasonography in accurate identification of dilatation of the common bile duct as 96% and 95% respectively but was less accurate at detecting common duct stones (sensitivity 36%, specificity 98%).[14,15]

Whereas Einstein D *et al* found out the sensitivity of detecting choledocholithiasis as 22% and of dilatation of common duct as 23%.[16]

The diagnostic accuracy of US is operator dependent but it is also influenced by some clinical features of patients (shadowing from bowel gas, overweight and stone size).[17]

Other imaging modalities like multidetector CT, endoscopic ultrasound and MRCP can also detect CBD stones with much accuracy. CT scan findings depend upon the size of stone in CBD. Stones larger than 5mm can be detected in 96% of cases however smaller than 5 mm are detected in only 67% cases. It also depends on composition of stones. Pure cholesterol stones are difficult to detect on CT.[13] EUS has a sensitivity of 100% and specificity of 80% for detection of CBD stones.[10] The sensitivity of MRCP for detection of choledocholithiasis range from 50 to 100% while specificity ranged from 83 to 100%.[18,19]

The current study was conducted in the local setting and at national level by enrolling a substantial sample population with suspected choledocholithiasis. We kept in our mind financial constraints faced by our patients also less health facilities and services in our country, and came to the point that transabdominal ultrasound has an important role and may be the first choice for the assessment of biliary tract pathology.

It was a single centre study; results were collected for only six months and no long term follow up of patients were made so results of study cannot be widely generalized.

## CONCLUSION

Our study concluded that transabdominal ultrasonography had a sound sensitivity and a high specificity in the detection of choledocholithiasis when compared with ERCP. By this non-invasive, radiation free, easily available and cost-effective method we can identify the high-risk patients, minimize the burden on resources, reduce the complication rate that can occur with diagnostic ERCP and a better outcome can be expected. ERCP can be reserved for therapeutic purposes only.

## AUTHORS' CONTRIBUTION

ZZ: Basic idea and execution of project especially ERCP. AJ: Basic input in idea, execution and Write up and review. TF: transabdominal ultrasound. AA: references and review

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