The Accuracy of Transabdominal Ultrasound (TAUS) in Detection of Choledocholithiasis Keeping Magnetic Resonance Cholangiopancreatography (MRCP) as Gold Standard

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ABSTRACT

Objective: To assess the diagnostic accuracy of trans-abdominal ultrasound (TAUS) in detecting choledocholithiasis, keeping MRCP as the gold standard.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Magnetic Resonance Imaging, Armed Forces Institute of Radiology & Imaging, Pak Emirates Military Hospital, Rawalpindi Pakistan, from Jun 2018 to May 2019.

Methodology: 102 patients of either gender, age 20-85 years with the clinical suspicion of choledocholithiasis and obstructive jaundice were included. Trans-abdominal ultrasonography was performed for radiological detection of disease. All selected cases then underwent MRCP for confirmation of findings.

Results: Mean age of the patients was 54.27 ± 15.14 years. 47 patients (46.1%) were males, and 55 (53.9%) were females. All patients were subjected to trans-abdominal ultrasound and MRCP. TAUS showed choledocholithiasis in 82 (80.3%) patients. MRCP confirmed choledocholithiasis in 81 (79.4%) cases, whereas 21 (20.5%) revealed no choledocholithiasis. Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of TAUS were 96%, 80.9%, 95%, 85% & 87.86%, respectively.

Conclusion: Diagnostic accuracy of trans-abdominal ultrasonography in detecting choledocholithiasis is significantly high enough to be used as a first-line imaging modality as MRCP is available only in specialised care centres.

Keywords: Choledocholithiasis, Magnetic resonance cholangiopancreatography (MRCP), Trans-abdominal ultrasonography (TAUS).

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INTRODUCTION

Magnetic resonance cholangiopancreatography (MRCP) is considered a superior modality due to its multi-planar multi-planar imaging capability and better soft tissue differentiation.[1,2] It has become the main imaging modality in evaluating obstructive jaundice due to the non-requirement of IV contrast and sedation and radiation-free imaging to assess various aetiologies of obstructive jaundice in the hepato-biliary system.[3,4] MRCP is considered the gold standard for verifying stones in the common bile duct in suspected cases of obstructive jaundice due to choledocho-lithiasis.[3] Previous literature showed the accuracy of MRCP in detecting the location of pancreatobiliary obstruction as 100%, which is superior to that of USG and CT scan.[5]

MRCP is non-invasive and does not require the use of contrast material or ionising radiation, which makes it a safe investigation.[6] In addition, because of its technical versatility, superior soft-tissue contrast resolution and multi-planarmulti-planar capability, it is a more reliable imaging technique than other mentioned modalities.[7] Once the diagnosis is confirmed, the patient can be sent for definite therapeutic management. Stones in CBD can be managed endo-scopically by ERCP or open surgical procedure/laparoscope. MRCP also becomes important as it is being used increasingly in patients to select those who require a therapeutic intervention.[8] Its diagnostic capability is equal to that of ERCP, and hence it can be used as a replacement for ERCP in high-risk patients to limit significant morbidity.[9,10]

This topic has been selected to highlight the importance of trans-abdominal ultrasonography (TAUS) in diagnosing choledocholithiasis in our setting as it is usually employed as the first line, is affordable and non-invasive imaging examination is available in most places.[2] The rationale of this study was to assess the accuracy of TAUS as a diagnostic tool in detecting

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choledocholithiasis, keeping MRCP as the gold standard.

This study will help us decide whether TAUS, which is a commonly employed non-invasive imaging modality, can be a valuable preliminary procedure for the detection of common duct stones or not. A positive finding on TAUS can go on in helping the patient be spared extra pre-operative expensive diagnostic tests leading to a significant reduction of workload and expenses on the patient's part. Moreover, deciding on a screening modality, in the long run, help in the planning of proper management of patients leading to a noteworthy reduction in morbidity and mortality in these cases.

METHODOLOGY

It was a cross-sectional study conducted over 12 months, from June 2018 to May 2019. The study was approved by the Ethical Review Board Committee, AFIRI (IERB approval certificate no: 07). With the help of WHO sample size calculator, sample size of 102 patients was calculated (Confidence level=95%, prevalence of choledocholithiasis=45%, sensitivity of TAUS= 80%, specificity of TAUS= 87.5%, desired pre-cision= 10%).[11]

Inclusion Criteria: Patients of either gender and age ranging from 20-85 years with suspicion of choled-ocholithiasis were included in the study.

Exclusion Criteria: Patients with gall bladder and liver tumours, patients with the following foreign devices: aneurysmal clips, cochlear implants, cardiac pacemakers and prosthetic heart valves were excluded from the study.

After informed consent and relevant history, trans-abdominal ultrasound was performed with a curvilinear probe (1-5 MHz) using the axial, subcostal and intercostal approaches. Ultrasounds were initially performed by a radiology resident (minimum two years of training) and confirmed later by a classified radiologist who had more than five years of experience. The entire anatomic course of CBD from porta hepatis to the pancreatic head was studied on USG to identify the level of obstruction and extent of the CBD dilatation. All the selected cases were diagnosed as choled-ocholithiasis and then underwent MRCP for confir-mation. MRCP was performed on a 1.5-Tesla/3 Tesla MRI system, using a phased-array body coil. The rad-iology resident supervised MRCP scans. Reporting was done by the classified radiologist (minimum of five years of experience).

Statistical Package for Social Sciences (SPSS) version 25.0 was used for the data analysis. The frequency and percentages were calculated for choledocholithiasis, and mean ± SD were calculated for age distribution. A 2×2 table was constructed, and sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of TAUS keeping MRCP as the gold standard was calculated. The *p*-value of ≤0.05 was taken as statistically significant. Likelihood ratios were measured, and ROC curve analyses were done to analyse area under the curve (AUC). Spearman rank correlation analysis also estimated the degree of correlation between findings of TAUS and MRCP.

RESULTS

There were 102 patients in our study with the mean age of 54.27 ± 15.14 years (age range: 20-85 years). Out of these 102 patients, 47 (46.1%) were males, and 55 (53.9%) were females. All the patients were subjected to transabdominal ultrasonography and MRCP. USG showed the choledocholithiasis in 82 (80.3%) patients. MRCP findings confirmed choled-ocholithiasis in 81 (79.4%) cases, whereas 21 (20.5%) revealed no choledocholi-thiasis (Figure-1).

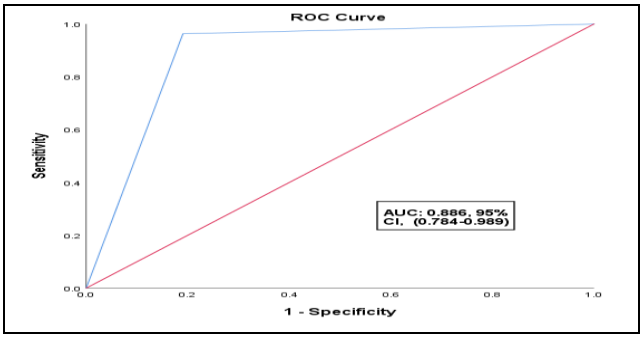

Figure-1: ROC Curve analysis for area under the curve (AUC) for trans-abdominal ultrasonography.

On USG-positive patients, 78 were true positive while 4 were false-positive. Among 20 USG-negative patients, 3 were false-negative while 17 were true-negative, as shown in Table-I.

Table-I: Two by two-contingency table for diagnostic accuracy of transabdominal ultrasonography (TAUS) in detection of choledocholithiasis keeping magnetic resonance cholangiopancreatography as gold standard.

	Positive Result On MRCP	Negative Result On MRCP
Positive Result On TAUS	78 (True Positive)	4 (False positive)
Negative Result On TAUS	3 (False Negative)	17 (True negative)

Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of TAUS in detecting choledocholithiasis, keeping MRCP as the gold standard was 96%, 80.9%, 95%, 85% and 93.14%, respectively (Table-II). Like-lihood ratios for the probability of positive and negative results were also calculated and found to be 5.06 and 0.05, respectively.

Table-II: Diagnostic parameters of Trans-Abdominal Ultrasonography (TAUS) in detection of Choledocholithiasis keeping Magnetic Resonance Cholangiopancreatography as gold standard.

Parameters	Definitions	Values n (%)
Total Number of Cases	**n**	**102**
Sensitivity	TP/(TP+FN)	78/81 (96%)
Specificity	TN/(TN+FP)	17/21 (80.9%)
Positive Predictive Value	TP/(TP+FP)	78/82 (95%)
Negative Predictive Value	TN/(FN+TN)	17/20 (85%)
Accuracy	(TP+TN)/(N)	95/102 (93.14%)

ROC curve analysis showed TAUS to be statistically significant in distinguishing groups with and without choledocholithiasis in patients with obstructive jaundice (AUC: 0.886, 95% CI: 0.784-0.989), as shown in Figure-2. Spearman rank correlation analysis revealed a significant correlation between the findings of TAUS and MRCP (r: 0.787, p <0.001).

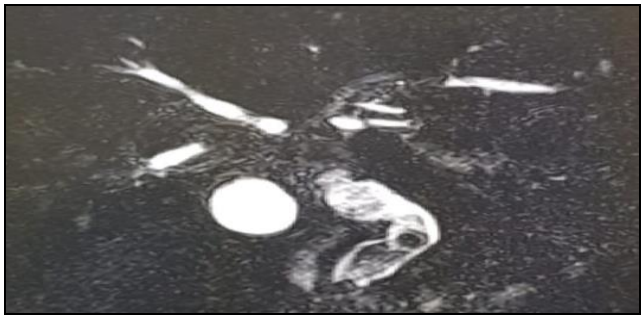

Figure-2: Magnetic resonance cholangiopancreatography showed calculus within mid part of common bile duct with upstream dilatation.

DISCUSSION

This study showed that modern high-resolution TAUS with significantly high diagnostic accuracy, being non-invasive, readily available and inexpensive, should be employed as a first-line imaging modality in all suspected cases of choledocholithiasis. In selected cases confirmed on USG, ultrasonography alone may suffice for accurate pre-operative assessment and selection of surgical technique, thus foregoing the need for technically complex and expensive techniques like MRCP available only in specialised care centres.

TAUS is usually employed as a first-line radiological tool for liver and gall bladder diseases in most health care settings,[11,12] as it is affordable and non-invasive. TAUS is ideal for gall bladder imaging because the gallbladder lies close to the skin, with no intervening gut gas shadows. Hence, TAUS can detect gallstone with a sensitivity of 96%.[13]

In another study by Virzì *et al*, conducted in Italy in 2018 exploring the correlation of findings of MRCP with surgical findings in symptomatic gallstone patients, the sensitivity of MRCP was found to be 97.5%. It had a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 90.9%.[3]

The differences in sensitivity are mostly attributable to the difficulty of approaching the distal CBD and ampullary region in obese patients and due to the variability of techniques used. Another factor could be the poor resolution of ultrasound machines, as those studies were done in older times. Haubek *et al,* in 1981 showed that ultrasonography has a high sensitivity of up to 97% in diagnosing the cause of obstructive jaundice.[14]

With the advent of new high-resolution machines, the success in diagnosing pathologies of the biliary tree keeps on increasing.[15] In a study by Varghese et al, ultrasound was found to have a specificity of 100% and accuracy of 89% in diagnosing choledocholithiasis.[16] Likewise, the sensitivity and specificity of USG in diagnosing choledocholithiasis were 100% and 89%, respectively, in another study conducted by Karki *et al*, in Nepal.[17]

In a study on benign obstructive lesions of CBD, Verma *et al,*[18] demonstrated the sensitivity and specificity of 85.3% and 88.4% on ultrasound, 84.6% and 94.2% on CT, 92.3% and 86% on MRCP. For same type of lesions Ferrari *et al,*[19] had similar findings with diagnostic accuracy, sensitivity and specificity as 78.62%, 16.67%, 97.29% on USG; 92.59%, 92.3%, 92.85% respectively on CT imaging and 93.13%, 90%, 94% respectively on MRCP. The diagnostic accuracy, sensitivity and specificity of USG for choledocho lithiasis were 96%, 93.3% and 97.14%, respectively, in a study by Singh *et al*.[20]

USG is a non-invasive imaging modality for choledocholithiasis. However, it has relatively low sensitivity for diagnosing stones in the distal part of CBD due to interference of bowel gases.[21] Stones in the mid part of CBD have moderate sensitivity and specificity, whereas the sensitivity and specificity for detecting calculi in proximal CBD are high.[22,23] An-

other limitation of ultrasonography for detecting common bile duct stones is variability in the expertise of the operators. However, USG was found to have relatively comparable sensitivity and specificity for proximal CBD calculi to that of MRCP and ERCP. The calculated sensitivity, specificity, PPV and NPV for MRCP in detecting choledocholithiasis were much higher than those for USG and almost comparable to those of ERCP. It was also unaffected by the skills of the operator.[24]

STUDY LIMITATIONS

There were a few limitations in our study. Since it was conducted at a single centre in an urban environment, the results may not generalise to the whole population. Post-operative findings could also be assessed in correlation with radiological imaging findings to strengthen their accuracy further. Lastly, findings on TAUS may be prone to observer bias. In summary, the findings of our study point toward the utilisation of TAUS as a primary tool for the primary diagnosis of choledocholithiasis in obstructive jaundice.

CONCLUSION

Diagnostic accuracy of trans-abdominal ultrasonography in detecting choledocholithiasis is significantly high enough to be used as a first-line imaging modality as MRCP is available only in specialised care centres.

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