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Utility of common bile duct measurement in emergency department point of care ultrasound: A prospective study

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ABSTRACT

Background: Measurement of the common bile duct (CBD) is considered a fundamental component of biliary point-of-care ultrasound (POCUS), but can be technically challenging.

Objective: The primary objective of this study was to determine whether CBD diameter contributes to the diagnosis of complicated biliary pathology in emergency department (ED) patients with normal laboratory values and no abnormal biliary POCUS findings aside from cholelithiasis.

Methods: We performed a prospective, observational study of adult ED patients undergoing POCUS of the right upper quadrant (RUQ) and serum laboratory studies for suspected biliary pathology. The primary outcome was complicated biliary pathology occurring in the setting of normal laboratory values and a POCUS demonstrating the absence of gallbladder wall thickening (GWT), pericholecystic fluid (PCF) and sonographic Murphy's sign (SMS). The association between CBD dilation and complicated biliary pathology was assessed using logistic regression to control for other factors, including laboratory findings, cholelithiasis and other sonographic abnormalities.

Results: A total of 158 patients were included in the study. 76 (48.1%) received non-biliary diagnoses and 82 (51.9%) were diagnosed with biliary pathology. Complicated biliary pathology was diagnosed in 39 patients. Sensitivity of CBD dilation for complicated biliary pathology was 23.7% and specificity was 77.9%.

Conclusion: Of patients diagnosed with biliary pathology, none had isolated CBD dilatation. In the absence of abnormal laboratory values and GWT, PCF or SMS on POCUS, obtaining a CBD measurement is unlikely to contribute to the evaluation of this patient population.

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1. Introduction

Biliary disease is common in the United States. Approximately 20 million patients present to the emergency department (ED) annually with complaints related to cholelithiasis [1-4]. Laboratory serum testing is routinely performed, but is generally not sufficient to differentiate between specific biliary diagnoses [5-7]. The use of ultrasound (US) is instrumental in clarifying the diagnosis and guiding treatment [8-10]. In general, uncomplicated symptomatic cholelithiasis can be managed expectantly with symptom control and outpatient referral to surgery. Conversely, complicated biliary pathology, such as acute cholecystitis, choledocholithiasis and ascending cholangitis, warrants more urgent consultation and hospitalization for further diagnostic study or definitive treatment.

Several studies have shown that point of care ultrasound (POCUS) can lead to accurate diagnosis of biliary pathology and expedite patient

care [1,11-13]. POCUS of the right upper quadrant (RUQ) typically assesses for the presence of gallstones, gallbladder wall thickening, pericholecystic fluid (PCF), sonographic Murphy's sign (SMS) and common bile duct (CBD) dilatation [14,15]. Despite being considered a fundamental element of RUQ POCUS, proper identification and accurate measurement of the CBD can prove technically challenging [3,16]. In the face of uncertain CBD identification, the ability of normal laboratory tests and an otherwise normal RUQ US to exclude complicated biliary pathology would be of great clinical benefit. Prior research has suggested that CBD diameter yields limited unique clinical information in patients with cholecystitis and choledocholithiasis with normal laboratory values; however, there are no prospective studies to date that have confirmed these findings [17-21].

We sought to prospectively assess the importance of sonographic CBD measurement in evaluating patients for biliary pathology, particularly in the setting of normal laboratory values and an otherwise unremarkable biliary US. We predict that the incidence of concerning biliary pathology in patients with normal laboratory values and no significant ultrasound finding beyond uncomplicated cholelithiasis is small

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and measurement of the CBD in this setting is unlikely to alter diagnosis or change management. The primary objective of this study was to determine if there is any utility to measure a CBD diameter in patients with normal laboratory values and a RUQ POCUS without GWT, PCF and SMS for the diagnosis of complicated biliary pathology in ED patients.

2. Materials and methods

2.1. Study design

We performed a prospective, observational study of adult ED patients receiving serum laboratory studies and undergoing POCUS of the right upper quadrant (RUQ) for evaluation of potential biliary pathology. Final diagnoses were assessed with respect to POCUS findings and laboratory results to determine the relative contribution of CBD measurement.

2.2. Study setting and population

The study was performed at an academic level 1 trauma center with an emergency medicine residency and an emergency ultrasound fellowship program. The ED has an annual census of 50,000 visits with an ethnically and economically diverse patient population. The local institutional review board approved the study prior to screening or enrolling patients.

2.3. Selection of participants

We enrolled a convenience sample of adult patients presenting to the ED between November 2012 and September 2014 with abdominal pain and concern for biliary pathology based on the history and physical examination. Undergraduate emergency medicine research associates screened for potential patients daily between the hours of 8:00 am and 12:00 midnight. Patients were eligible for inclusion if they were at least 18 years old, able to provide written and verbal consent in English or Spanish, and were undergoing both a RUQ POCUS and serum laboratory testing as part of their clinical evaluation. All laboratory tests and imaging studies were performed at the discretion of the ordering physician. Patients were excluded if they were pregnant, incarcerated or did not meet inclusion criteria. The research student obtained informed written consent from eligible patients after discussion of the study with the treating physician.

2.4. Study protocol

Following the screening and consent process, included patients underwent laboratory blood work and a RUQ POCUS performed by the treating emergency physician. A total of 26 resident, fellow and attending physicians actively consented patients and performed the POCUS. Physician sonographers possessed various levels of training and did not receive any study-specific instruction regarding biliary sonography. Data collected included patient age, gender, body mass index (BMI), sonographic findings, laboratory values and final diagnosis. All data were recorded by research associates using a standardized data collection instrument. Images were stored on a secured picture archiving and communication system for review.

The following serum laboratory values were collected and considered abnormal if exceeding the institutional upper limit of normal range: alkaline phosphatase (ALP, >100 μ L), alanine aminotransferase (ALT, >40 μ L), aspartate aminotransferase (AST, >45 μ L), total bilirubin (TB, >1.6 mg/dL) and white blood cell count (WBC, >11,000/mcL) [15]. A given patient was considered to have “abnormal” labs if any one of the above laboratory values exceeded the corresponding upper limit of normal. All enrolled patients received at least the aforementioned tests. The decision to obtain additional laboratory studies, such as lipase, was left

to the discretion of the treating physician, but the results of these tests were not collected as part of the study.

Further management of the patient including CT scan or radiology performed ultrasound was left to the discretion of the treating physician based on their usual clinical approach. This also included specialist consultation, hospitalization or discharge from the ED. The gold standard was based on the final diagnosis which was collected directly from the emergency physician note for patients discharged from the ED and the hospital discharge summary for hospitalized patients. Final diagnosis included ERCP results and surgical pathology. Discharged patients were contacted by telephone approximately two weeks after initial presentation to determine if there was any change in final diagnosis or if they required another ED visit or hospitalization. If the patient was not reached at two weeks, calls continued monthly for up to 1 year. If a patient was unable to be reached via telephone for 1 year, the patient was excluded from the study.

Final diagnoses were classified as non-biliary or biliary. The latter was defined as any biliary tract pathology providing a likely etiology for the patient’s presenting complaint. This group was further classified into two categories: uncomplicated cholelithiasis (biliary colic) and complicated biliary pathology, which included any biliary diagnosis necessitating hospitalization for further diagnostic evaluation or definitive treatment, including, but not limited to, acute cholecystitis, choledocholithiasis, cholangitis and pancreatitis.

2.5. Ultrasound technique

All included patients underwent a POCUS performed by the treating emergency physician prior to review of blood work. The physician performing the ultrasound was blinded to laboratory results. No study-specific ultrasound training was provided, but all emergency medicine residents had completed a basic ultrasound training session at the time of matriculation to the program. This included 1 h of didactics and 3 h of hands on scanning. Each US examination was initiated in the supine position. Additional maneuvers, such as left lateral decubitus positioning, was left to the discretion of the individual physician sonographer. Standard sonographic assessment of the gallbladder included the presence or absence of gallstones, pericholecystic fluid (PCF) and SMS (sonographic Murphy’s sign), as well as measurements of the anterior gallbladder wall and CBD diameter. All POCUS findings were recorded contemporaneously by emergency medicine research associates at the bedside. US images were acquired with a Sonosite Edge (Sonosite FUJIFILM, Bothell WA) using either a 3.5-5 MHz curvilinear or a 1–5 MHz phased array transducer.

An US was deemed “abnormal” if any one of the following were present: anterior gallbladder wall thickness >3 mm (GWT), PCF or SMS. The presence of gallstones and dilated CBD were each considered separate and distinct abnormalities to facilitate statistical analysis. CBD dilation was defined as an internal diameter >6 mm for patients 60 years of age or younger. For patients >60 years of age, an additional 1 mm was added to the upper limit of normal for each subsequent decade of life.

2.6. Outcome measures

The primary outcome was to determine if cases of complicated biliary pathology occurred in the setting of normal laboratory values and a POCUS demonstrating the absence of GWT, PCF and SMS. We predict that a negative POCUS and normal lab values will be associated with a sensitivity >95% for non-complicated biliary pathology.

2.7. Data analysis

Descriptive statistics were performed for patient demographic data. Proportions were calculated with associated 95% confidence intervals (CI) reported for key parameters. The association between CBD dilation

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