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The impact of a rapid imaging protocol in acute cholecystitis-prospective cohort study

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ABSTRACT

INTRODUCTION: In this study we assess the impact of a "rapid imaging protocol" (RIP) on outcomes in patients with suspected acute cholecystitis (AC).
METHODS: From January 2017 to January 2018, a prospective cohort study was implemented using a RIP with hepatoscintigraphy (HIDA) or CT scan (first available, goal within 4 h) in patients (n = 52) presenting with highly suspected AC and a clinical feature score of ≥1. For the latter, the following presenting features were scored as follows: 1 point for WBC count ≥10,000 (10^9/L), 1.5 points for glucose ≥140 (mg/dl), and/or 1 point for age ≥50 yrs. The historical control was all patients admitted with suspected AC in a 1.5-year period (n = 117) under our previous "delayed imaging protocol" (DIP), which used US ± HIDA (post-admission) in select patients. Primary end points included: compare outcome and quality measures between the groups, evaluate diagnostic imaging performance for AC, and evaluate our proposed clinical feature score in the setting of AC.
RESULTS: Histopathologic features consistent with AC was more frequent in patients in the RIP (64% vs 39%, p = 0.008). The pooled positive predictive value of HIDA and CT scan for AC were 85% vs 94%, respectively. The RIP was associated with a significant reduction in time to surgery, length of stay, and conversions to open (p < 0.001, respectively). A clinical feature score of 3.5 predicted the likelihood of AC in 95% of the cases (x^2 for linear trend = 42, p < 0.001).
CONCLUSION: A protocol centered around rapid identification, defined clinical criteria (i.e. clinical feature score), and confirmation with non-user dependent imaging modalities has resulted in favorable outcomes. CT may be the study of choice when the likelihood of AC is high because it is superior at identifying severity.

1. Introduction

Acute cholecystitis (AC) requires prompt diagnosis to reduce perioperative morbidity and complications [1,2]. Modern guidelines recommend the diagnosis be made with a combination of clinical features, laboratory work up, and imaging confirmation [3,4]. For the latter, ultrasound has been the most commonly used diagnostic modality but performance in the setting of AC has been questioned by multiple reports [5,6]. Hepatoscintigraphy (HIDA) scan is the gold standard imaging modality in AC, however, its use is limited to centers that have access. Computed tomography (CT) may have high diagnostic yield but few studies have evaluated the performance of CT in the setting of AC [7,8]. In this prospective study, we evaluate a rapid imaging protocol (RIP) using HIDA or CT in highly suspected AC and compare outcomes of this protocol with our previous protocol.

2. Methods

From January 2017 to January 2018 (one year), a prospective cohort study was implemented using a rapid imaging protocol (RIP) with HIDA or CT scan (first available, goal within 4 h) in patients (n = 52) presenting with highly suspected AC. All patients presented to the emergency room (ER) and first contact was made by an ER physician. A high suspicion for AC was determined if the patient presented with progressive RUQ pain and/or positive Murphy's sign, and a clinical feature score of ≥1. For the latter, the following presenting clinical features were scored as follows: 1 point for WBC

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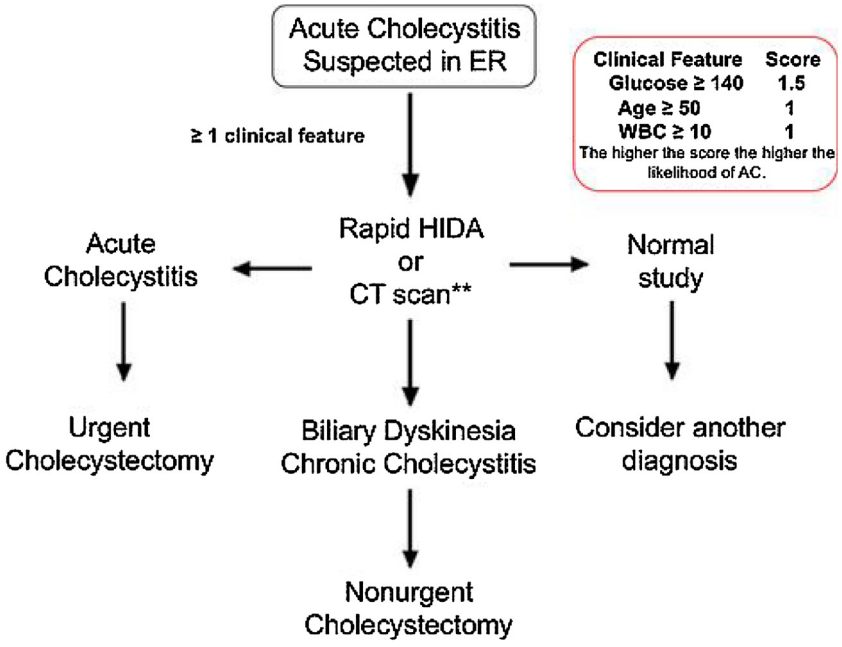

Fig. 1. Rapid imaging protocol for acute cholecystitis. **HIDA, hepatobiliary scintigraphy. CT scan, abdominal computed tomography without contrast.

count ≥10,000 (10^9/L), 1.5 points for glucose ≥140 (mg/dl), and/or 1 point for age ≥ 50 yrs. Laboratory work up also included parameters to exclude other hepatobiliary pathologies (i.e. choledocholithiasis, cholangitis, pancreatitis, hepatitis, etc.). If a high clinical suspicion remained after initial work up, the patient would then proceed with a HIDA or CT scan (first available, goal within 4 h), and the patient was managed accordingly (see Fig. 1). Some patients in the RIP received immediate ultrasound by the first contact ER physician in their preliminary work up, but if they met criteria for the study they were included and the RIP was followed accordingly. Most patients (overall, 50/52 cases) would eventually undergo laparoscopic or open cholecystectomy, and a final histopathologic diagnosis with our institutional pathologist. The operations were performed by the on-call/admitting surgeon (5 surgeon experience) with the assistance of a junior or senior general surgery resident in all cases. The content of this study has been reported in line with the PROCESS criteria [12].

For our historical control (i.e. "delayed imaging protocol," DIP) we reviewed records of all patients that were admitted through ER in a 1.5-year period (January 2013 to July 2014) with a preliminary diagnosis of AC. During this time, the majority received an ultrasound in ER and select patients received a delayed HIDA post admission. All patients underwent cholecystectomy during the admission.

Primary end points included: 1) assess the performance of US, HIDA, and CT scan as imaging modalities in suspected AC, 2) compare outcome and quality measures (time to surgery, length of stay, costs, etc.) between the RIP vs DIP, and 3) evaluate our proposed clinical feature score in the setting of AC.

2.1. Clinical feature score

The features of the clinical feature score were determined by multivariate analysis of all presenting baseline clinical and laboratory findings in the historical group (n = 117). The details of this analysis have been previously described [9]. When all presenting features were analyzed, WBC count ≥10,000 (10^9/L), glucose ≥140 (mg/dl), and age ≥50 years were the three presenting features that had a statically significant positive association with pathologically confirmed acute cholecystitis. Therefore, the clinical feature score was derived using a regression coefficient based scoring system from the multivariate regression analysis. Specifically, the regression coefficient (RC) for glucose ≥140 was 1.5 (yielding a score of 1.5). WBC count ≥10,000 and age ≥50 years both had an RC of 1 (yielding a score of 1), respectively.

2.2. Imaging protocol

2.2.1. Abdominal ultrasound (US)

All the abdominal US performed in this study were done prior to admission in the ER setting. Sonographic analysis was performed by a certified ultrasound technician and interpreted by a board-certified radiologist. All interpretations were done in real time and the original radiologic interpretation was not changed (i.e. the radiologist was not given the opportunity to carry out a second review for this study). The final US interpretation was determined as follows:

- Findings consistent with AC: sonographic Murphy's sign, pericholecystic fluid, gallbladder distension (≥4 cm short axis), and/or thickening of the gallbladder wall (≥3 mm). Visualization of one of the four major signs was interpreted as positive for AC. If these one or more of these findings was not clearly identified the study was interpreted as negative for acute cholecystitis.
- Cholelithiasis: Visualization of none of the above four signs with gallstones.

2.2.2. HIDA

A dynamic biliary study was performed following the intravenous administration of 6.1 mCi of Tc-99 m Choletec (a hepatobiliary radiopharmaceutical agent). Sequential scintigraphic images of the abdomen in the anterior projection up to 60 min was done to evaluate for radiotracer distribution/activity throughout the hepatic parenchyma, intrahepatic ducts, gallbladder, common bile duct, and small bowel at 60 min. If no visualization of the gallbladder was present 1 h into the study, morphine (5 mg) was given intravenously to stimulate retrograde filling of the gallbladder. No visualization of the gallbladder at 30 min following morphine administration in the proper clinical setting, this scintigraphic find-