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Brief Report

Assessment of emergency physician–performed ultrasound in evaluating nonspecific abdominal pain

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ABSTRACT

Study objective: The objective of this pilot study was to lay the groundwork for future studies assessing the impact of emergency physician–performed ultrasound (EPUS) on diagnostic testing and decision making in emergency department (ED) patients with nonspecific abdominal pain (NSAP).
Methods: This was a prospective, noninterventional study using a consecutive sample of patients presenting to the ED with NSAP as determined by nursing triage when a participating physician was available. *Nonspecific abdominal pain* was defined as abdominal pain for which the patient was seeking evaluation without a presumed diagnosis or referral for specific evaluation. Patients were evaluated by a physician who documented their differential diagnosis and planned diagnostic workup. Then, the physician performed EPUS, recorded their findings, and documented their post-EPUS differential diagnosis and planned diagnostic workup. This was compared with the patient's final diagnosis as determined by 2 emergency physicians blinded to the EPUS results.
Results: A total of 128 patients were enrolled. Fifty-eight (45%; 95% confidence interval [CI], 36%-54%) had an improvement in diagnostic accuracy and planned diagnostic workup using EPUS. Sixty-four (50%; 95% CI, 41%-59%) would have been treated without further radiographic imaging. Fifty (39%; 95% CI, 31%-48%) would have been treated without any further laboratory testing or imaging.
Discussion: Based on our findings, a future trial of 164 consecutive patients would have 90% power to confirm a 25% reduction in testing and a 25% improvement in decision making.
Conclusion: Emergency physician–performed ultrasound appears to positively impact decision making and diagnostic workup for patients presenting to the ED with NSAP and should be studied further.

1. Introduction

Emergency physician (EP)–performed ultrasound (EPUS) can improve the care of emergency department (ED) patients with undifferentiated hypotension [1], trauma [2,3], and first-trimester pregnancy [4-6] but has not been studied in ED patients with nonspecific abdominal pain (NSAP). In a study of patients requiring surgical evaluation, surgeon-performed ultrasound improved the diagnostic accuracy for appendicitis and biliary disease [7]. Likewise, among patients requiring sonologist evaluation, ultrasound altered the treatment plan 47% of the time [8]. However, in a study of patients undergoing computed tomography (CT), radiology ultrasound helped diagnose some patients but performed poorly for others [9]. These studies involved extensively trained sonographers in high-risk populations, so it is still unclear how EPUS impacts a more diverse patient population with NSAP. Therefore, the purpose of this pilot study was to facilitate the design of future studies by assessing how EPUS (as opposed to sonologist or surgeon-performed ultrasound) might impact diagnostic testing and decision making in ED patients with NSAP.

2. Methods

2.1. Study design

This was a prospective, noninterventional, observational, institutional review board–approved study using a sample of consecutive patients presenting with NSAP between June 1, 2006, and June 1, 2007, when a participating EP was available to obtain informed consent and perform EPUS for the evaluation of NSAP.

2.2. Study setting

This study was conducted at 2 urban, academic EDs with a combined annual adult census of 82 000 visits and emergency medicine residency programs. Hospital 1 is in the Midwest. Hospital 2 is on the West Coast.

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2.3. Selection of participants

All patients presenting to the ED with NSAP as determined by nursing triage were eligible for enrollment if a participating EP was available to perform EPUS. *Nonspecific abdominal pain* was defined as abdominal pain for which the patient did not have a presumed diagnosis or referral for specific evaluation. Patients were excluded if they were referred for specific evaluations such as "rule out appendicitis," complained of an acute exacerbation of a chronic problem, had a positive pregnancy test, or were unable to speak English. The determination of patient chief complaint was done by computerized nursing triage.

Of 36 EPs who met the American College of Emergency Physicians (ACEP) training guidelines [10], 20 (55%) consented to participate and completed an orientation on the study protocol.

2.4. Protocol

Participating EPs consented the patient, performed a history and physical examination, and completed a standardized data sheet regarding their differential diagnosis (DDX), ranked from 1 (most likely) to 5 (least likely), and planned diagnostic workup, ranked from 1 (most necessary) to 5 (least necessary). Then, EPUS was performed in a goal-directed fashion with results recorded on a second standardized data sheet, and the EP completed a third standardized data sheet regarding their post-EPUS DDX, ranked from 1 (most likely) to 5 (least likely), and post-EPUS planned diagnostic workup, ranked from 1 (most necessary) to 5 (least necessary). On this third data sheet, EPs were able to specify if they would forego further diagnostic workup based on the additional information obtained by EPUS. The third data sheet (post-EPUS) was compared with the first data sheet (pre-EPUS) relative to the criterion standard to asses if EPUS improved the DDX and planned diagnostic workup.

Emergency physician–performed ultrasound was performed in a goal-directed fashion at the discretion of the EP in accordance with ACEP guidelines [10] and consistent with standard practice where signs and symptoms determine necessary workup. For example, if the DDX included gallstones and a ruptured abdominal aortic aneurysm (AAA), the EP would perform biliary and aortic EPUS, but not bladder EPUS. A priori, it was determined not to require a complete abdominal ultrasound at the request of the institutional review board at hospital 2 because ED patients presenting with abdominal pain typically undergo a goal-directed ultrasound rather than a complete abdominal ultrasound. Hospital 1 used a Sonosite Titan (Sonosite, Bothell, WA), and hospital 2 used an Ultrasonix CEP (Ultrasonix, Richmond, British Columbia, Canada) during the study period. Images were recorded but not reviewed post hoc because image quality was presumed based on the EPs meeting ACEP training guidelines, and the purpose of this study was to assess how EPUS would impact decision making and diagnostic workup in real time.

As a noninterventional study, the EPs enrolling the patients and performing EPUS were not primarily responsible for the patients. Treating clinicians were blinded to the results of EPUS except in the case where the patient would have been placed at risk by such blinding. For example, if EPUS revealed an 8-cm AAA in a patient in whom the treating clinician considered reflux disease to be the most likely diagnosis, then such findings could be conveyed to the treating clinician.

2.5. Criterion standard

Two EPs, blinded to the results of EPUS and the standardized data sheets, reviewed every patient's chart and clinical course, including nursing and physician notes, laboratory data, radiographic investigations such as CT, inpatient hospital course if admitted, and operative or pathology reports if available to determine the patient's final diagnosis. Patients were also contacted by telephone after 30 days to determine if any other diagnoses were made. This was considered the criterion standard. It was predetermined to have the 2 physicians review any discrepant findings a second time, with a third physician "tie-breaking" review for cases with persistent differences.

Table 1
Predetermined preferred/"appropriate" workup algorithms

Diagnosis	Preferred workup algorithm
Appendicitis	1. CT
Bowel obstruction	2. Complete blood count and comprehensive metabolic panel
Colitis	3. Urinalysis
Diverticulitis	
Mesenteric ischemia	
Ruptured AAA	
Biliary disease	1. Ultrasound
Pancreatitis	2. Complete blood count, comprehensive metabolic panel, lipase, and/or amylase
	3. Urinalysis
Hepatitis with or without ascites	1. Complete blood count and comprehensive metabolic panel without imaging
GERD	
Ureterolithiasis	1. Ultrasound
	2. Urinalysis
	3. Complete blood count and comprehensive metabolic panel
	CT only if moderate or severe obstruction[a]
Ovarian cyst	1. Ultrasound
Tubo-ovarian abscess	2. Urinalysis
	3. Complete blood count and comprehensive metabolic panel
PID	1. Urinalysis
Pyelonephritis	2. Complete blood count and comprehensive metabolic panel without imaging
UTI	

Abbreviations: *GERD*, gastroesophageal reflux disease; *PID*, pelvic inflammatory disease; *UTI*, urinary tract infection.
[a] Computed tomography would be indicated if the ultrasound showed moderate to severe hydronephrosis.

2.6. Study measurements

The first outcome measure was the impact on DDX, determined by comparing the pre-EPUS and post-EPUS DDX relative to the criterion standard diagnosis. If the criterion standard diagnosis moved up the DDX, this was considered an improvement in diagnostic accuracy. If the criterion standard diagnosis moved down the DDX, this was considered a worsening in diagnostic accuracy.

The second outcome measure was projected impact on diagnostic workup. The primary end point for this measure was the cessation of further testing. The secondary end point for this measure was whether diagnostic testing would improve, based upon predetermined diagnostic workup algorithms for specific diagnoses. Table 1 describes the preferred diagnostic workup algorithms.

2.7. Data analysis

Data were collected in an Excel database (Microsoft Excel; Microsoft Corporation, Redmond, WA) and analyzed using SAS version 9.1 (SAS Institute, Cary, NC). Descriptive statistics were calculated for all variables. Power Analysis and Sample Size Software (NCSS, LLC., Kaysville, UT) was used to estimate the sample size needed for the future interventional study.

3. Results

A total of 213 patients presented to the ED with NSAP as determined by computerized nursing triage when one of the participating EPs was available (Fig.). Thirty-three were pregnant, and 30 were non–English speaking, leaving 150 eligible patients during the study period. A total of 128 patients were enrolled (85%)