The Journal of Emergency Medicine, Vol. 50, No. 6, pp. 859–867, 2016
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0736-4679/$ - see front matter

http://dx.doi.org/10.1016/j.jemermed.2015.06.085

Ultrasound in Emergency Medicine

DIAGNOSTIC ACCURACY OF EMERGENCY PHYSICIAN–PERFORMED ULTRASOUND FOR ACUTE APPENDICITIS IN A REMOTE LOCATION

François Topin, MD,*† Anne-Lise Thierry, MD,* Olivier Catrevaux, MD,†‡ Thibault Barnoux, MD,†§ Paul Menguy, MD,†|| Antoine Bertani, MD,†¶ Pierre-Laurent Massoure, MD,†# Yann Geffroy, MD,# Jean-Pierre Tourtier, MD,** and Jacques Bougère, MD†

*Bataillon de Marins-Pompiers de Marseille, Marseille, France, †Hôpital Médico-Chirurgical, Bouffard, Djibouti, ‡Service des Urgences, Hôpital d'Instruction des Armées Bégin, Saint-Mandé, France, §Service Médical Matignon, Paris, France, ||Clinique Les Orchidées, Le Port, Réunion, ¶Hôpital d'Instruction des Armées Desgenettes, Lyon, France, #Hôpital d'Instruction des Armées Laveran, Marseille, France, and **Brigade des Sapeurs-Pompiers de Paris, Paris, France

Reprint Address: François Topin, MD, Bataillon de Marins-Pompiers de Marseille, 9 Boulevard de Strasbourg, 13233 Marseille Cedex 20, France

☐ **Abstract—Background: Preoperative imaging for suspected acute appendicitis (AA), such as ultrasonography (US), was shown to improve diagnostic accuracy and patient outcomes. Criteria for diagnosis of AA by US are well established and reliable. In previous studies, US assessments were always performed by skilled radiologist physicians. However, a radiologist and computed tomography scanning equipment are not always available in the community hospitals or remote sites of developing countries. Objective: Our aim was to assess a diagnostic pathway using clinical evaluation, routine US performed by an emergency physician, and clinical re-evaluation for patients suspected of having AA. Methods: Patients suspected of having AA admitted to the emergency department in a developing country were prospectively enrolled between November 2010 and January 2011. Clinical and US data were studied. A noncompressible appendix with a diameter ≥6 mm was the main US diagnosis criterion. Results: Among the 104 included patients, surgery was performed on 28. Of the 25 patients with positive US, 22 actually had AA, matching the surgical report. The remaining 76 patients without US appendicitis criteria underwent clinical follow-up and had medical conditions. Sensitivity of US was 88%, specificity was 96%, positive predictive value was 88%, and negative predictive value was 96%. The likelihood ratios for our US assessment highlight the need for a test with enhanced diagnostic accuracy. Conclusions: A diagnostic strategy using clinical evaluations, routine US performed by emergency physicians, and clinical re-evaluation of patients with acute abdominal pain is appropriate to provide positive results for the diagnosis and treatment of appendicitis in remote locations.** © 2016 Elsevier Inc. All rights reserved.

☐ **Keywords—acute appendicitis; emergency; ultrasound; remote site; Horn of Africa**

INTRODUCTION

Although acute appendicitis (AA) is one of the most common challenging surgical diseases, it has been considered uncommon among African populations in Africa and in the developing world (1). But in the last few decades, despite a paucity of data, some authors have reported an increasing incidence of AA in Africa (2,3). In addition, the high rate of advanced appendicitis (ie, free perforations, abscesses) in Africa, 40%–50% vs. 20% in

This work was performed at Hôpital Médico-Chirurgical Bouffard, Djibouti.

The work has been approved by the appropriate ethical committees related to the institute.

RECEIVED: 16 November 2014; FINAL SUBMISSION RECEIVED: 2 June 2015;
ACCEPTED: 12 June 2015

industrialized countries, illustrates the impact of a delayed presentation (3,4). The mortality rates for appendicitis in African series vary from 0.9% to 4% vs. 0.5% in Western countries (5,6).

Management of patients with clinically suspected appendicitis is sometimes obvious from clinical examination, but numerous possibilities for misdiagnosis remain, leading to potentially delayed therapeutic management. Therefore, any examination by an emergency physician that improves the accuracy of clinical diagnosis is helpful. To this end, use of ultrasound (US) in the diagnostic evaluation is relevant because it is noninvasive, does not expose the patient to radiation, is reproducible, is inexpensive, and is a readily available examination (7).

Poor economic conditions, lack of radiologists, and shortages of medical imaging equipment prevail in developing countries. Therefore, the adoption of sonography as the primary imaging means for the provision of care in such remote locations contributes to improving diagnostic accuracy and shortening patient treatment time in austere environments for civilian, humanitarian, and military purposes.

Further, the use of US has spread widely in emergency departments (EDs) during the past few decades. The increasing use of US techniques, coupled with the lack of radiologic imaging, led us to design a study to assess the role of emergency physician–performed US for the diagnosis of AA.

We assume that an emergency physician properly trained in abdominal sonography should be able to perform an abdominal US for appendicitis at the time of initial evaluation with an accuracy comparable to an examination performed by a radiology specialist physician. Determination of the diagnostic accuracy of emergency physician–performed US is carried out by an investigation of the sensitivity, specificity, and likelihood ratio (LR) of US for diagnosing appendicitis, the nonvisualized appendix, and the negative appendectomy rate (NAR).

MATERIALS AND METHODS

Location of the Study

The Republic of Djibouti has a population of about 800,000 inhabitants, two-thirds of which live in the capital; the remainder are nomadic herders. The proportion of the population living in absolute poverty is 42%. During the 1991 to 1994 civil war, the economy and the public and private health systems were seriously damaged. Even today, the health system is unable to supply the population with the quantity and quality of required services. There is a lack of facilities and equipment, and especially inadequacies in qualified medical staff, due to an overall under-investment in health care.

The study was conducted in the ED of Bouffard French military hospital, in the capital city of Djibouti, Republic of Djibouti, Horn of Africa. The main mission of this hospital is to support the health of the French military task forces and their families and the Djiboutian army and their families, as well as to provide free health care to the local population.

With 50 beds and a catchment area serving a population of about 500,000 people, the French military hospital provides basic surgical, medical, obstetric, and pediatric services, and has minimal pharmacy and laboratory facilities. Electrical power cuts are frequent. At the time of the study, there was not a radiologist physician available, the computed tomography (CT) scanner was under repair, and only plain x-ray equipment was readily available.

Patients

During a 12-week period from November 2010 to January 2011, prospective data for 104 consecutive patients referred to the ED for potential appendicitis were collected. Emergency physicians undertook patient examinations and collected clinical data, such as localization of abdominal pain, the migratory character of the pain, the pain-level rating, the presence of sudden painful decompression on the right iliac fossa or diffuse in the abdomen. Hyperthermia was determined $\geq$38.5°C measured with a tympanic thermometer. Laboratory tests (leukocyte count and C-reactive protein [CRP] assays), urine analysis, and abdominal US were performed in the ED. Leukocytosis was deemed present when $>10^{10}$ cells/L, and CRP cutoff value was 50 mg/L.

At admission, body mass index (BMI) was considered to be normal when <25 kg/m^2, overweight when between 25 and 30 kg/m^2, and obese when >30 kg/m^2. Clinical scores assessments were not performed. Any patient referred for acute abdominal pain had the benefit of these routine and free-of-charge examinations.

Ultrasound Equipment and Interpretation

US was performed by one of the three emergency physicians on duty in the ED of Bouffard French military hospital. These clinicians were holders of academic diplomas in focused emergency US that were earned with between 6 months and 3 years of US daily experience in their respective EDs before their posting to Djibouti.

This 2-year postgraduate US diploma teaches the use of goal-directed focused US examinations and promotes bedside US dictated by the clinical situation. It is composed of a theoretical and practical curriculum, with 80 h of theory covering basic, advanced, and critical

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