



Lung ultrasound by emergency nursing as an aid for rapid triage of dyspneic patients: a pilot study



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1. Introduction

Dyspnea is a subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity (Zimmermann et al., 1994). Patients suffering from dyspnea or shortness of breath commonly seek care in the emergency department (ED) (West, 1985). Anticipating the dangerous diagnoses that cause this complaint and preventing the associated morbidity and mortality from such conditions has been the primary focus of emergency medicine. Differential diagnosis of dyspnea is an important issue for emergency physicians (EPs) to guide the appropriate treatment of patients. Treatment decisions and evaluation of the dyspneic patients must be conducted at the same time. The indiscriminate use of bronchodilator treatment in patients who do not have a history of chronic obstructive pulmonary disease (COPD) is associated with a greater need for 'aggressive interventions', including mechanical ventilation and the need for intravenous vasodilators (Singer et al., 2008). Bedside lung ultrasonography (BLUS) has become an increasingly valuable diagnostic tool in various pulmonary and cardiac diseases, especially in emergency conditions (Copetti et al., 2008; Kirkpatrick et al., 2004; Lichtenstein and Mezière, 2008; Ünlüer and Kara, 2013; Ünlüer et al., 2012, 2013a, 2013b). There is a growing body of

evidence that shows that patient care is improved when BLUS is included in the diagnostic workup of such patients. Use of ultrasonography (USG) in pre-hospital care and in EDs could potentially provide critical information about dyspneic patients and could thereby optimize the early treatment of patients with dyspnea. The portability, accuracy, and non-invasiveness of the USG give it potential as an effective imaging modality to provide diagnostic information in an emergency setting. In addition, the traditional physical examination often has significant limitations in the diagnosis of cardiopulmonary pathology (Johnson and Carpenter, 1986; Liang and Schnittger, 2003; Mangione and Nieman, 1997).

Our objective was to evaluate the accuracy of emergency nurse (EN)-performed BLUS for diagnosing dyspnea as having a cardiac or a non-cardiac cause in patients admitted to the ED.

2. Material and methods

2.1. Setting

This study was a prospective, cross-sectional cohort study that was conducted from 1 to 30 May 2013 at an academic, adult tertiary care center ED of a university hospital in Turkey. In our ED, at least two emergency medicine specialists with eight residents of emergency medicine work in each shift. No patients have been discharged from the ED without establishing a final diagnosis by eight emergency medicine specialists or ten consultant physicians. The local Ethics Committee approved the study protocol. Written

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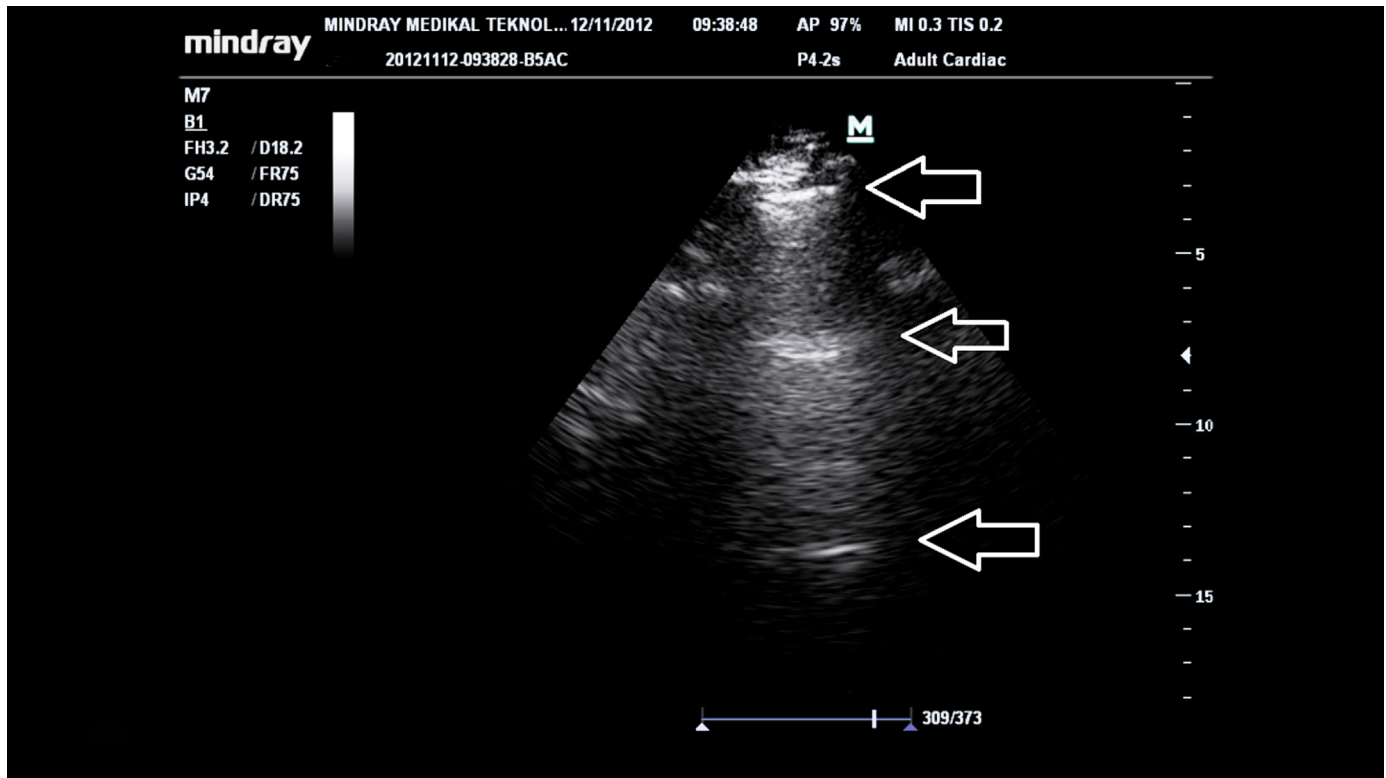


Fig. 1. Sonographic visualization of A profile. White arrows show the horizontal hyperechoic lines parallel to the pleural line present on each hemithorax which is called A-line.

informed consent was obtained from each volunteer prior to their sonographic examinations.

2.2. Sample

All ED patients who were admitted with the complaint of dyspnea were screened for this study by two trained ENs with a bachelor's degree and at least 5 years' experience in our ED at the time of presentation before other diagnostic tests were performed. The treating physicians were not informed of the results of the BLUS to prevent any potential morbidity from the use of a misinterpreted examination. Patients were ineligible if they were aged <18 years, had acute chest pain, were pregnant, were hypotensive (systolic blood pressure lower than 90 mmHg), had had previous thoracic surgery or if the USG performers could not get the optimal image because of technical limitations. We had recruited 96 patients by the end of the study period approved by ethical committee. Prior to the study, two ENs had 3 hours of theoretical training by video as well as hands-on training with 60 patients led by an experienced radiologist and an EP (Gudmundsson et al., 2005).

2.3. Protocol

The BLUE protocol, which is an internationally accepted method for BLUS, based on careful analysis of lung ultrasound, was developed by Lichtenstein and Mezière (2008). According to this protocol, as the first step, the performer evaluates the chest only anteriorly and the search of the posterior lung areas is not required since it does not affect the decision tree of the physician. Specifically designed for the BLUE protocol, the BLUE points make lung ultrasound simple. They are standardized and therefore reproducible, associating clinical efficiency and ease of use. The normal artifact is the repetition of the pleural line, a roughly horizontal

hyperechoic line parallel to the pleural line. We called this artifact the A-line. Air blocks the ultrasound beam, which comes back to the central unit, yielding this regular artifact. The distance between the pleural line and the A-line is equal to the skin-pleural line distance. The main other artifact is the vertical B-line (Lichtenstein, 2010a). According to the BLUE protocol, the B profile designates anterior predominant bilateral B-lines and demonstrates pulmonary edema. The lung surface generates A or B lines with no space for intermediate artifacts. This demonstrates that the transformation from A to B lines occurs all of a sudden, following an all-or-nothing rule, when a critical amount of fluid has thickened the interlobular septum (Lichtenstein, 2010b; Lichtenstein and Mezière, 2008).

The ENs categorized the patients with dyspnea as having a cardiac or a non-cardiac cause according to the presence of a B or an A profile in the BLUS. The BLUS was diagnosed as an A profile and also as there being a non-cardiac cause if there was a repetition of the pleural line; that is, a roughly horizontal hyperechoic line or lines parallel to the pleural line (called the A-line) present on each hemithorax (Fig. 1) (Lichtenstein, 2010a). If there were vertical hyperechoic lines originating from the pleural lines and going toward the bottom of the ultrasonography monitor (called the B-line), the patient was diagnosed as having a B profile and a cardiac cause of dyspnea (Fig. 2). Characteristics for the diagnosis of a B profile were the presence of B-lines on each hemithorax, vertical hyperechoic lines originating from pleural lines, the presence of well-defined and laser-like shaped extensions towards the bottom of the screen, the obliteration of the A-lines, and coordinated movement with the pleural line (Lichtenstein, 2010c). Volpicelli et al. (2006) declared the necessity of identifying characteristic B lines in at least two zones on each side of the chest to make the sonographic diagnosis of pulmonary edema and also to differentiate the focal B-lines from the diffuse ones (Volpicelli et al., 2006).

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