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REVIEW

Pocket-sized focused cardiac ultrasound: Strengths and limitations

Échoscopie à l'aide d'échographe de poche : avantages et inconvénients

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Summary Focused cardiac ultrasound (FCU) has emerged in recent years and has created new possibilities in the clinical assessment of patients both in and out of hospital. The increasing portability of echocardiographic devices, with some now only the size of a smartphone, has widened the spectrum of potential indications and users, from the senior cardiologist to the medical student. However, many issues still need to be addressed, especially the acknowledgment of the advantages and limitations of using such devices for FCU, and the extent of training required in this rapidly evolving field. In recent years, an increasing number of studies involving FCU have been published with variable results. This review outlines the evidence for the use of FCU with pocket-echo to address specific questions in daily clinical practice.

Abbreviations: ESC, European Society of Cardiology; FCU, Focused cardiac ultrasound.

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Résumé L'avènement de l'échoscopie a ouvert des possibilités diagnostiques nouvelles ces dernières années, à la fois en pré-hospitalier et à l'hôpital. Les échographes de poche sont des appareils de la taille d'un téléphone portable. Ils permettent une grande mobilité ouvrant l'éventail d'utilisateurs potentiels, allant du cardiologue expérimenté à l'étudiant en médecine. De nombreuses questions demeurent néanmoins sans réponse à ce jour. Une attention particulière doit être portée aux avantages et aux limites de l'utilisation de ces appareils pour l'échoscopie afin d'en assurer une bonne utilisation. Les modalités de formation restent aussi à préciser. De nombreuses études ont été publiées ces dernières années avec des résultats variables. Cette revue résume le niveau de connaissances actuelles de l'échoscopie à l'aide d'échographes de poche.

Introduction

History taking and clinical examination alone do not always allow precise cardiac diagnoses. Point-of-care echocardiography ultrasounds, using portable devices, has emerged as a bedside tool in many specialities, from trauma to neonatology [1]. However, a particularly challenging area is likely to be focused cardiac ultrasound (FCU) because a wide variety of patients need assessment of ventricular function and estimation of filling pressures in different settings. Several studies have shown incremental benefit when FCU is added to the general physical examination, and investigators have suggested that FCU will someday become an integral part of the physical examination and could even replace the stethoscope [2—8].

Technological advances have led to the miniaturization of echocardiographic machines, with gradually smaller portable devices. Pocket-echocardiography is defined by the size of the devices: small enough to fit into a coat pocket, slightly larger than a smartphone. The use of pocket-echo necessarily implies FCU due to the limited functions of these devices. The relatively low cost and high portability of these devices make them accessible to a wide range of practitioners in different settings: at the bedside, in or out of hospital, from the outpatients' cardiology clinic to the intensive care unit. Before rapid and uncontrolled proliferation of these devices, there is an urgent need to address indications, protocols, limitations and training for the optimal use of pocket-echocardiography [9].

When assessing the accuracy and feasibility of pocket-echocardiography for FCU, three components are particularly important:

- image quality and technical limitations due to the device;
- the expectations practitioners have of FCU;
- expertise of the user/reader.

Some studies have addressed these issues separately and others in combination. In this review, we explore the current level of evidence for the use of different pocket-echo devices for FCU in daily clinical practice.

Reliability of FCU with pocket-echocardiography in different clinical scenarios

In experienced hands, pocket-echocardiography may be of significant diagnostic value when used in conjunction with physical examination [2—8]. Systematic use of FCU may lead to a change of management and/or diagnosis in up to 20% of patients for whom comprehensive echocardiography was not requested after traditional clinical assessment [3,5,8].

Left ventricular size and function

FCU by pocket-echocardiography enables the user to answer several simple questions of importance in daily practice (Table 1). One of the most reproducible measurements across studies is semi-quantitative left ventricular ejection fraction, with a sensitivity to detect left ventricular systolic impairment of 74—97% and a specificity of 94—99% when compared to comprehensive echocardiography [4,6,10—18]. Left ventricular dilatation (Fig. 1A) may also be assessed with sensitivity and specificity of 71—94% and 97—100%, respectively [11,15—19]. Regional wall motion abnormalities may not be as accurately assessed as left ventricular ejection fraction or left ventricular dilatation [10,19]. However, FCU by pocket-echocardiography would miss many cases of heart failure with preserved ejection fraction due to the lack of pulsed-wave Doppler and tissue Doppler [20].

Lung ultrasound: assessment of extravascular lung water

Extravascular lung water results in some comet-tail reverberation artefacts, called B-lines or ultrasound lung comets. The absence of multiple bilateral B-lines excludes cardiogenic pulmonary oedema with a negative predictive value close to 100% [21] (Table 1). In the presence of breathlessness, ultrasound lung comets may also be readily visualized by non-experienced users, and are of prognostic value [22]. Lung ultrasound may also be helpful to detect pleural effusion (Fig. 1B) and identification of pneumothorax, pulmonary consolidations and acute respiratory distress syndrome [23].

Filling pressure estimation

It is also of interest to be able to estimate the loading conditions in patients with breathlessness or circulatory failure. The inferior vena cava diameter (Fig. 2A) and its respiratory variation may be useful to guide appropriate medical treatment [24—26]. However, the sensitivity and specificity to accurately assess this parameter by FCU vary considerably from one study to another [4,11,13,15,27] (Table 1). This may partly be explained by difficulties in