

Risk and safety in the evaluation of the critically ill patient. Can POCUS become a support tool?

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The appearance of the miniaturized ultrasound (US) devices and wireless transducers together with the development of “*sonostethoscope*” type applications has led to the increase of the US examination in clinical emergency situations and decision-making algorithms. In this informative context, a new branch of US examination called “*Point of Care Ultrasonography*” (POCUS) has appeared. It allows the integration in daily practice of imaging during clinical examination, early diagnosis of life-threatening injuries and implicitly the quick emergency situations’ decision-making, regardless of where the patient is: in prehospital settings, emergency departments (ED), intensive care units, operating rooms, but also in outpatient clinics or family doctor’s offices.

The development of POCUS-type clinical applications, however, requires evidence related to the standardization of examination tools, the development of practice guidelines, the risks of using visual medicine, and the accreditation of training programs for medical personnel from students to practicing physicians.

The new concept of using integrated US in the clinical examination, such as a „*sonostethoscope*”, at the patient’s bedside, does not replace the classic US examination. However, it offers the opportunity to have quick decisions based on some US aspects, allowing the doctor to answer some clinical questions and to perform life-saving therapeutic procedures: a) FAST - Sonographic Scoring for Operating Room 0-1 has a positive predictive value of 0.99 for no need of laparotomy [1]; b) POCUS – CA quickly identifies reversible causes of cardiorespiratory arrest: cardiac tamponade, pulmonary thrombo-

embolism, pneumothorax, hypovolemia [2]; c) POCUS performed in the ED within the first hour of arrival of a non-traumatic shock, reduces the time to the therapeutic decision by 26.7 minutes [3].

The American College of Emergency Physicians (ACEP) classifies emergency POCUS into five functional clinical categories: *resuscitative* (POCUS use directly related to an acute resuscitation), *diagnostic* (POCUS utilized in an emergent diagnostic imaging capacity), *symptom or sign-based* (POCUS used in a clinical pathway based upon the patient’s symptom or sign), *procedure guidance* (POCUS used as an aid to guide a procedure), and *therapeutic and monitoring* (POCUS use in therapeutics or physiological monitoring) [4].

The role of POCUS in daily practice in order to optimize emergency medical care is well known, but some questions arise: What is the risk of diagnostic errors while using POCUS examination in the ED, for the potentially critically ill patient? What are the risks of using POCUS in the ED in terms of examination technique? Does the use of POCUS integrated into clinical algorithms increase the safety of the medical act? How do we develop a POCUS training program that reduces risk and increases medical act safety? Is the risk of not using POCUS higher for the medical act and the patient?

Published studies show that “bedside POCUS” in ED is associated with improved diagnosis, reduction of the time to the first therapeutic intervention ($p=0.00003$), number of medical interventions ($p=0.0009$), number of additional examinations ($p=0.00002$), duration (number of days) of hospitalization in intensive care ($p=0.01$) [5].

Advantages versus risks of using POCUS

For over 50 years, US diagnosis has proven to be fast, non-ionizing, non-radiating, ensuring practitioners in many specialties an optimal imaging diagnosis for medical care and, at the same time, reasonable cost efficiency in conditions of financial restrictions or poor

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equipment. Thus, the profile companies sent the message that POCUS represents a safe imaging tool in the emergency assistance centers, in the case of the potentially critically ill patient. Portable devices offer practitioners quick answers to clinical questions and imaging support for decision-making in borderline situations, isolated areas or with poor equipment.

However, there are some risks related to the *safety, efficiency and use of the imaging tool*. Thus, the Agency for Healthcare Research and Quality (AHRQ) and Joint Commission give POCUS examination 2 out of 10 points of technological risk for health, provided there is adequate training, experience and practical use skills [6-8].

Regarding the *safety*, the risk of bacterial transmission during the examination and the importance of reduction through decontamination and sterilization procedures are emphasised. Also, protecting the transducer from contact with pathological products (blood, drainage fluids, etc.) reduces the risk of hepatitis B, C and HIV transmission [9]. The risks of examining some organs and tissues or examining under certain conditions are also considered: the safety of fetus examination in pregnant women, the examination of the eye, the examination of the newborn. Thus, a thermal index at tissue level of 0.5 is recommended, respectively a mechanical index below 0.4 (variation between 0 - 1.9), especially in newborns, children or when examining tissues that have air content to avoid the cavitation phenomenon [9].

There is a low awareness of *the risks of the use of portable ultrasonography devices* among clinicians, which at the level of the Australian College for Emergency Medicine has led to the development of emergency use guidelines and policies for different clinical applications [9-12]. *Formal education and protocol establishment, with limited skills* (FAST, eFAST, FATE, etc.) condition the non-use of these devices in areas without formal training, reducing diagnostic errors by applying in day-to-day practice the different algorithms included under the POCUS umbrella [9].

Medical act safety versus POCUS competence

In the last years the POCUS examination was defined as an extension of the practitioner's stethoscope but this imaging test requires training, credentialing, competence and assessment. Clinical applications that represent safe practices to reduce medical errors, such as the use of real-time ultrasound guidance of central venous catheter insertion were described [13,14]. Ultrasonography is undoubtedly a diagnostic imaging method highly dependent on the examiner and the environment in which it is performed, requiring training to understand the basic

semiology, but also the possibility of incorporation into POCUS-type algorithms. The data from the literature clearly showed the reduction of diagnostic times (from 186 ± 72 min to 24 ± 10 min), the reduction of unnecessary diagnostic interventions, as well as unnecessary additional irradiations in ED or intensive care patients [15,16]. POCUS can be a powerful and attractive tool to increase the safety of the medical act by improving the diagnosis and guidance of invasive procedural maneuvers. There are hospitals that have adopted specific ultrasonographic applications (e.g. POCUS assessment of volemic status) for certain departments [13,17].

In conclusion, POCUS represents a *fast, affordable, portable* imaging examination method, with increased precision and accuracy in the conditions of the existence of a standardized training program at a national or international level. For implementation, it is necessary to define a training curriculum, to monitor the quality of the examination, to establish the limits of the competence offered by the program and the risks of extension in other clinical applications. Risk management of the POCUS use requires adequate infrastructure, standardized training, image storage solutions (image library), documentation of the examination process, methods and quality assurance pathway to ensure practitioner competence.

However, POCUS represents a new concept and the trend for future and needs to be introduced as a training program at student and resident level. Research and practical evidence related to the educational process and the safety of visual medicine integrated into medical practice, will bring new information regarding the use of ultrasonography by practitioners in decision making and reducing medical errors, an essential need of current health systems.

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