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PREHOSPITAL ULTRASOUND: INCIDENCE OF REALIZATION AND IMPACT ON PATIENT MANAGEMENT

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ABSTRACT

In a two-tiered pre-hospital emergency system, the miniaturization of ultrasound machines has allowed their increased use within Advanced Life Support teams in spite of a systematic absence of university education. A retrospective study in an urban area aimed to measure the incidence of pre-hospital ultrasound (PHU) performance. A secondary objective was reporting the reasons for carrying out PHU and its impact on patient management.

Over a one-year period, 3760 patients were taken charge of by an ALS team; 204 of them (5.4%) benefited from PHU. Pathologies involved were trauma (n = 130; 63.7%), chest pain (n = 32; 15.7%), cardiac arrest (n = 14; 6.9%), shock (n = 11; 5.4%), pregnancy (n = 5; 2.4%), and others (n = 12; 5.9%). There was no relationship between pathologic PHU and, respectively, the administration of a specific treatment ($p = 0.13$), or the decision to direct the patient to a particular department ($p = 0.85$).

The low incidence of performing PHU was explained essentially by the absence of systematic sonography training, and by the absence of specific pre-hospital guidelines. If PHU does not impact the management of a cohort in an urban milieu, it may influence hospital destination in a rural environment where the nearest hospitals are not always equipped with a complete technological platform. Additional investigations are needed on this topic. Training of emergency physicians in ultrasound must be reinforced.

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INTRODUCTION

In a two-tiered pre-hospital emergency system, the miniaturization of ultrasound machines has led to a transfer of competencies from radiologists to pre-hospital emergency physicians. Guidelines regarding the hospital practice of emergency ultrasound are already in place [1]. The primary objective of this study was to measure the incidence of realization of pre-hospital ultrasound (PHU) by Advanced Life Support (ALS) teams. Secondary objectives included reporting the reasons for performing PHU and evaluating its impact on patient management.

MATERIALS AND METHOD

This was a retrospective study involving practice in an urban area. The pre-hospital emergency rescue system was handled by ALS teams in which the emergency physician had at his/her disposal a Vscan™ ultrasound machine (General Electric Healthcare®).

Criteria for inclusion applied to all patients taken charge of by an ALS team for whom the realization of PHU and its result were noted in the medical chart. Variables recorded were age, gender, pre-hospital diagnosis (chest pain, shock, cardiac arrest, trauma, pregnancy, others), the type of PHU performed (thoracic, vascular, abdominal, focused assessment with sonography for traumas "eFAST", other), its result, and subsequent patient management. The latter included therapies instituted, the type of transport basic life support ambulance or ALS team), and the admission service: emergency room (ER), intensive care unit (ICU), operating room (OR).

The profile of the emergency physicians was determined in part based on individual questionnaires. Recorded variables were time of practice of pre-hospital emergency medicine, the type of ultrasound training received, and the length of experience in ultrasound.

Results are expressed as mean (standard deviation), median (interquartile range, IQR), or number (%) with 95% confidence interval. All statistical calculations were performed with the use of STATA/SE (Version 14.0; StataCorp., College Station, TX, USA).This study was approved by the Ethics Committee of the French Association of Anesthesia and Intensive Care *(Société Française d'Anesthésie et de Réanimation)*.

RESULTS

Over a one-year period (from May 2015 to May 2016), ALS teams took charge of 3760 patients. PHU was reported in 204 (100%) patients, or a rate of PHU performance of 5.4%. Of these, 137 (67.1%) were men; the average age was 44±23 years. Pathologies involved were trauma (63.7%), chest pain (5.7%), cardiac arrest (6.9%), shock (5.4%), pregnancy (2.4%), and others (5.9%). Considering use of ultrasound by type of pathology, PHU was performed in 23.1% of trauma patients, 7.9% of pregnant patients, 4.1% of shock victims, 3% of patients with cardiac arrests, 2.8% of patients with chest pain, and 2.3% in others.

Patients included in the study benefited from 226 (100%) PHU; 22 patients underwent two types of ultrasound. The most frequently carried out PHU were eFAST (53.1%), thoracic ultrasound (28.7%), abdominal and obstetrical ultrasound (13.3%), and other (ultrasound-guidance of venous puncture or of loco-regional anesthesia, or bony ultrasound; 4.9%). Sixty-six of 226 PHU (29.2%) presented a pathological image. According to bivariate analysis, the discovery of a pathological image was not associated with administration of a specific pre-hospital treatment (p = 0.13).If only trauma patients were considered, the association between an abnormal eFAST and OR admission tended to be significant (p = 0.054). The association between pathologic PHU and hospital destination disappeared completely if only pathologies other than severe trauma were considered (p = 0.85).

Prior experience of emergency physicians (n = 18) in the pre-hospital field was six years [IQR:4-12.25]. Their experience of using ultrasound was two years [IQR:1-4]. Eight (44.4%) had undergone university training specific to ultrasound, 7 (38.9%) had had non-university level training (day- or week-long internship), and 3 (16.7%) had never undergone any specific training.

DISCUSSION

This is the largest cohort involving the study of pre-hospital ultrasound practice by ALS teams. The low rate of patients benefiting from PHU is explained by several factors. First, it is likely that the performance of PHU was not systematically recorded in the medical chart. The rate of PHU found is thus a minimal estimate. Second, ultrasound training was not required and the level of training of emergency physicians was heterogeneous. In 2016, the French Society of Emergency Medicine *(Société Française d'Anesthésie et de Réanimation)* defined the "first level of competency for clinical ultrasound in emergency medicine" intended for the emergency physician, without specifying an extra- or intra-hospital context or imposing any particular university training. It would be advisable that systematic university training be incorporated into future training curricula of emergency physicians [1]. Third, the absence of guidelines for PHU indications is noted, as contrasted with emergency intra-hospital ultrasound [2;3]. In the meantime, every pre-hospital ambulance service equipped with an ultrasound machine should have an internal protocol to validate PHU integration into the initial management of critical patients.

The result of an eFAST sonogram may influence therapeutic strategy as well as hospitalization approach [4;5]. Even though our study tends to confirm the impact of PHU on orientation for trauma victims, practitioners may yet experience the performance of the examination as a loss of time. On the one hand, in the case of inexperienced practitioners, this feeling may be due to the length of time required for its performance, and on the other hand, to an impression of the futility of the procedure given the proximity to specialized technological services in an urban environment. By contrast, in a rural milieu, nearby hospitals are not always equipped with complete technical facilities, and their access times are often longer. PHU can assist in resolving a dilemma that may then face the physician, in this case going to the nearest hospital equipped with standard technical facilities, or going further to a more specialized technical platform but at the price of a greater delay.

The benefit of pre-hospital ultrasound for non-trauma patients is less certain, since there is no study confirming that PHU would improve the management of these patients [6]. The examination can nevertheless contribute to narrowing the

diagnosis, and thus to guiding therapeutic choices or the choice of hospital destination. In our experience, this situation applies to a very limited number of so-called "critical patients" not amenable to statistical evaluation.

This study has a number of limitations. It was mono-centric in an exclusively urban milieu. Furthermore, since performance of PHU was declared in the pre-hospital chart, the incidence of this exam was probably underestimated. The retrospective character did not allow us to define the significance of the association between pathologic PHU in the severe trauma patient and his/her hospital destination. Finally, the data obtained during the PHU (images and hours of performance) were not recorded.

CONCLUSION

The incidence of PHU realization within our cohort was low and most frequently associated with a traumatic context. In this last case, a pathologic eFAST tended to be associated with direct admission of the patient to the operating room. For the other pathologies, PHU did not modify either the therapeutic decision or the hospital approach. Ultrasound training of pre-hospital emergency physicians must be reinforced. It would be useful to conduct a similar study in a rural environment.

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