Brief Report

Stay and play eFAST or scoop and run eFAST? That is the question!☆

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The initial assessment is fundamental in trauma patients and starts
in a prehospital setting. It relies on an exhaustive, quick, and precise
examination of the patient. Therapeutic decisions and patient
outcomes are dependent on this primary examination. In light of
the nonspecific clinical features that are seen in patients with altered
mental status and delayed hemorrhage, extended focused assessment
sonography for trauma (eFAST) examination to check for intraperi-
toneal, pericardial, or pleural fluid may be an easy, fast, reproducible,
and noninvasive tool to improve prehospital clinical examination
performance [1]. The end point of this complementary ultrasono-
graphic examination is to reduce the incidence of injuries identified
late in the workup that are responsible for the largest number of
avoidable deaths [2].

Studies assessing eFAST efficiency are rare compared with those on
focused assessment sonography for trauma (FAST). Only Walcher et al
[3] have evaluated the diagnostic efficiency of eFAST in prehospital
settings. The results were similar to those of an in-hospital study
carried out by Ma et al [3,4], with a sensitivity and specificity of 100%
and 97.5% vs 90% and 99%, respectively. With prehospital FAST
studies, the examination was almost exclusively performed on-site.
The aim of this study was to compare the feasibility and the efficiency
of an eFAST examination performed on-site, during the patient’s
transfer, or repeatedly.

1. Materials and methods

The study was approved by the local ethics committee at the
Laveran Military Teaching Hospital. This prospective observational
study was conducted from February 2010 to June 2012 on the 3
mobile resuscitation ambulances of the Marseille Battalion of Mariner
Firefighters. This unit includes 30 emergency physicians (EPs)
working mostly in the prehospital field. Two-thirds had eFAST
qualifications for more than 4 years and had performed at least 5
eFAST examinations a month. The 30 EPs were divided randomly into 3 groups. Group 1 performed an ultrasound examination on-site; group 2, during the transfer; and group 3 performed these both on-site and during transfer. The eFAST examination was not random but systematically performed in all severe traumas or in patients who had a trauma whose mechanism or kinetics was severe enough to cause major injuries (French Vittel criteria, Table 1). Vittel criteria were used for inclusion of patients in our study. At least 1 criterion presented in Table 1 was necessary as specified in the definition to qualify as severe trauma. Only the criterion concerning a fall of more than 6 m was replaced by a fall of more than 3 floors to avoid any mistakes in assessing distance. These Vittel criteria are adhered to in Marseille with regard to sending patients to a care unit for severe trauma patients where a medical team carries out immediate management of the patient (clinical assessment, arterial and venous catheterization, eFAST, and transcranial Doppler) and decides the procedure to be followed (body scan, embolization,...).

The patients with an isolated distal limb trauma (below the elbow or the knee), those who died before reaching hospital, and those supported during interhospital transfers were excluded. We used the mechanism, Glasgow Coma Scale, age, and arterial pressure (MGAP) score, the only prehospital score that predicted mortality better than the Triage Revised Trauma Score (T-RTS) and as did the Revised Trauma Score (RTS), which is not easy to calculate [5]. The MGAP score was also able to clearly delineate patients with low, intermediate, and high risk of mortality (Table 2).

The eFAST examination assesses investigation of intraperitoneal, pericardial, and pleural effusion (Fig.). Emergency physicians had to answer a simple question: was there intraperitoneal, pericardial, or pleural effusion or not. Investigation of gaseous effusion was also carried out in 2B then by time motion mode. The contribution of the prehospital eFAST examination was compared with the results obtained on hospital admission by a radiologist. The ultrasonography examination was considered positive if it showed pleural, pericardial, or peritoneal effusion and negative if no pathologic image was seen. If intraperitoneal effusion was observed and, at the same time, no pleural effusion was found, although present on the scan, the assessment was considered to be incomplete and a false negative. We did not make a distinction at the intraperitoneal level between hepatoportal (Morison pouch), splenorenal (Koller pouch), or Douglas recesses. For each eFAST examination, the EP had to describe the difficulties encountered.

The results of each ultrasound examination were reported. A portable ultrasonography device was used, TITAN (SONOSITE) with a convex probe of 2 to 4 MHz. The eFAST examination was always timed with the setting of the device to the examination conclusions. The length of the intervention was defined by the time between the first medical contact and admission in the hospital unit.

1.1. Statistical analysis

Data were collected by 2 EPs and entered in a database. All statistical analyses were performed using statistical software. Data were treated with the Access 2010 software (Microsft; Washington, DC, USA). EPI INFO 3.5.1 (Epi Info Community Edition, Atlanta) was used for statistical tests. All continuous variables are expressed as means with SDs. All categorical variables are expressed as numbers with percentages. The results are expressed in terms of sensitivity (no. of true-positive test results in all patients), specificity (no. of true-negative test results in all persons), positive predictive value (no. of true-positive test results of all positive test results observed), negative predictive value (no. of true-negative test results of all negative test results observed), and efficiency (no. of true-positive and true-negative test results of all positive and negative test results observed).

The diagnostic performances were assessed by diagnostic efficiency and Youden’s index. A Wilcoxon rank sum test is used to compare the duration whether the examination was performed on-site, during the transfer, or both. The value less than 0.05 was considered statistically significant for all the tests.

2. Results

From October 2011 to June 2012, 98 patients underwent an eFAST examination and were included (Table 3). Forty-four eFAST
Examinations were performed on-site only (group 1): 33, during transport only (group 2); and 21, in both settings (group 3). All the eFAST examinations were complete. The eFAST feasibility was 95.4%, 93.9%, and 95.2%, respectively. The diagnostic efficiency and the examination durations are reported in Table 4. At the hospital, the first imaging tests performed were mainly whole-body computed tomographic (CT) scans in 72% (n = 71) and sonography for the rest of the cases. Whole-body CT was performed when patients were hemodynamically stable or stabilized at hospital admission. Otherwise, a radiologist carried out a new ultrasound examination when requested by the trauma center physician before deciding rescue surgery. There was no significant difference in duration whether the examination was performed on-site, during the transfer, or both (w = 0.68). Lastly, in 2 cases in group 3, the second examination carried out during transfer showed new results with the appearance of intraperitoneal effusion in one case and of pleural effusion in the other.

### 3. Discussion

The notion that ultrasonography may be helpful in a prehospital setting and during the transfer of traumatized patients is not new. In the early 1980s, Massen and Mercat [6] were already aware of the major role that ultrasonography could play during medical transfers: early diagnosis, on-site resuscitation and treatment, orientation of the patient toward a suitable center, more precise information for better management, and safety during transfer. Unfortunately, at that time, ultrasonography devices were heavy and bulky and required a continuous electric supply, which made them difficult, if not impossible, to use in a prehospital setting. Furthermore, the ultrasonography examination was limited by the vehicle movements, dorsal decubitus of the patient, the small space around the patient, and the short time dedicated to the examination, although these were not absolute barriers according to the same authors.

The first studies assessing the role of ultrasonography during medical transfer took place in the late 1990s, in particular in air medical evacuation [7-9]. Ultrasound use in the field has been described in Germany, France, Italy, and the United States as well as in other countries. The indications and utility of point-of-care ultrasound may differ. In few areas, care providers spend more time on the scene evaluating and managing patients, and physicians are often part of the field team. French intensive care physicians reported the contributive use of a portable ultrasonography device in a

### Table 3

<table>
<thead>
<tr>
<th>Population characteristics</th>
<th>Group 1: on-site eFAST, n = 44</th>
<th>Group 2: transfer eFAST, n = 33</th>
<th>Group 3: on-site and transfer eFAST, n = 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y) (mean/median/SD)</td>
<td>34/28/17</td>
<td>39/35/29</td>
<td>37/35/11</td>
</tr>
<tr>
<td>Trauma mechanism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic incident</td>
<td>34</td>
<td>27</td>
<td>15</td>
</tr>
<tr>
<td>Fall &gt; 6 m</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Aggression</td>
<td>6</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Trauma type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blunt</td>
<td>41</td>
<td>27</td>
<td>21</td>
</tr>
<tr>
<td>Penetrating</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>MGAP score [5]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low risk</td>
<td>30</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>Medium risk</td>
<td>10</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>High risk</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Fig. Extended FAST technique.
helicopter in 1998 [9]. In France, the major prehospital indication of ultrasound is eFAST. The German Air Rescue Organization (Deutsche Rettungsflugwacht) as well as several ground-based ambulance services have included ultrasound into their field management algorithms since 2002 and focused on the FAST examination and cardiac sonography for nontrauma patients in prehospital [10]. The Italian EMS system began integrating ultrasound in prehospital care in 2005, and 3 major clinical indications were evaluated: cardiac arrest, chest trauma, and acute dyspnea [10]. In the United States, flight crews consisting of flight nurses, paramedics, and physicians, who have to search for reversible causes of cardiac arrest, check for pericardial, intraperitoneal, and pleural fluid in trauma and distinguish pulmonary edema from emphysema. As in other countries applying the « scoop and run » strategy, emphasis is placed on fast transfer and shorter length of on-site management. Although the use of ultrasonography had been described in medical helicopter evacuations in Oregon, Ohio, and Minnesota, this “scoop and run” concept strongly slowed down the use of ultrasonography in out-of-hospital traumatized patients management algorithm [10].

In the literature, the contribution of on-flight ultrasonography examinations was significantly heterogeneous from one study to another. The main technical difficulties mentioned were positional difficulty depending on which side of the cabin the patient was installed, the dorsal decubitus position almost compulsory for trauma patients, the limited space around obese patients, flight turbulence, patient agitation, strong lightning, the lack of time to complete the examination due to short time flights or to unstable patients requiring on-flight therapeutics. The feasibility and efficiencies of on-flight ultrasonography are reported in Table 5 [11–16].

Paradoxically, there is no description of routine use of ultrasonography in emergency ambulances. In our study, the feasibility and efficiency of eFAST were similar whether on-site or during the transfer. The diagnostic efficiency was maximal if 2 examinations were done. A second examination during the transfer permitted the identification of 2 liquid effusions missed at first sight. The degree of contribution is difficult to compare between the different studies presented in Table 5. Emergency physicians making up our department have only been carrying out prehospital emergency medicine activities with fairly recent echographic experience and a limited number of examinations (<5 per month). In effect, a hospital physician who receives multitrauma patients on a daily basis will certainly achieve a more effective assessment of his echographic examination. The examination is operator dependent, and the expertise differs with the level of practice and experience. Thus, one must also take into consideration the time interval between the 2 examinations because this can alter the results. False-negative results can occur when the ultrasound examination is performed too soon [3,17].

Hemodynamically unstable patients at the trauma center only underwent an ultrasound assessment carried out by a radiologist. They did not have a scan and were treated to achieve hemostasis. Consequently, for 28% of patients, the combined result of echographic assessment by a radiologist and the operating report acted as the “gold standard.” For the rest, it was the scan carried out systematically within 30 minutes of admission and following echography carried out by the radiologist, which was the “gold standard.” In assessing the presence of fluid, we took into account the echographic threshold of detection, which according to several authors, is 250 mL for

### Table 4

Feasibility, efficiency, and duration of the eFAST examinations performed on-site, during the transfer, or both.

<table>
<thead>
<tr>
<th>Examination type</th>
<th>No. of patients</th>
<th>Feasibility</th>
<th>Sen</th>
<th>Sp</th>
<th>VPP</th>
<th>DE</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-site eFAST, n = 44</td>
<td>95.4% (42/44)</td>
<td>2 failures</td>
<td>18</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Transfer eFAST, n = 33</td>
<td>93.9% (31/33)</td>
<td>2 failures</td>
<td>85</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>On-site and transfer eFAST, n = 21</td>
<td>95.2% (20/21)</td>
<td>1 failure (hemostatic dressing)</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

### Table 5

Feasibility and efficiency of ultrasonography examinations during air medical evacuations

<table>
<thead>
<tr>
<th>Examination type</th>
<th>No. of patients</th>
<th>Feasibility</th>
<th>Sen</th>
<th>Sp</th>
<th>VPP</th>
<th>DE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polk et al [12,13]</td>
<td>Fast</td>
<td>84</td>
<td>NR</td>
<td>81%</td>
<td>NR</td>
<td>100%</td>
</tr>
<tr>
<td>Mazur et al [14]</td>
<td>Fast</td>
<td>38</td>
<td>94%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Heegaard et al [15]</td>
<td>Morison’s Pouch Pericard</td>
<td>100</td>
<td>90%</td>
<td>60%</td>
<td>93%</td>
<td>NR</td>
</tr>
<tr>
<td>Melansson et al [16]</td>
<td>Fast</td>
<td>71</td>
<td>48%</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

Abbreviation: NR, not reported.
intrapleural fluid and 100 mL for pleural fluid. The volume of effusion greatly affects the sensitivity of the echographic results. Nevertheless, in the population that we studied, no effusion found in the scan or during echographic assessment by a radiologist was below this threshold.

The duration of the examination was not dependant on the setting, and it was not too time consuming compared with the global duration of the intervention. On the other hand, when eFAST was done during the transfer, its duration represented a third of the transfer time. This result is biased regarding the short transfer times in our study due to a large number of hospitals in Marseille and to our almost exclusive downtown activity. Lastly, although our physicians had less experience than emergency practitioners in many other studies, there was no negative consequence in terms of diagnostic efficiency with the eFAST either on-site or during the transfer.

Our study has various limitations. It is a prospective observational single-center nonrandomized study with a small number of patients. Furthermore, our patients’ mean MGAP score, the only existing prognostic prehospital score for trauma patients, was low, and very few presented with penetrating trauma. To assess the efficiency of the eFAST examination in a prehospital setting, we compared its results to the first examination carried out in hospital so as not to create false-negative results due to delayed complementary imaging. Only 72% of the hemodynamically stable patients had a whole-body CT scan, which is the criterion standard examination but can only benefit to stable patients. As recommended, unstable patients at the admission time underwent an eFAST examination performed by a dedicated radiologist and then a surgical procedure. Although we did not have a CT for these patients, we assumed that the information provided by the radiologist’s examination and surgery were suitable comparison elements. We do not think this represents a bias because these unstable patients were treated as recommended, which allows for real-life conditions for our study. Further studies are needed to confirm these results.

4. Conclusion

The eFAST examination can provide reliable and important information in the initial evaluation of trauma patients. It can be carried out either on-site or during transfer. Wherever the examination is held, its feasibility and efficiency are similar to that carried out in intensive care units, especially when it is repeated. Obviously, the implementation of such an examination and its contributiveness depend not only on the length of the transfer but also on the availability, experience, and accuracy of the sonographer. Thanks to Dr LARGER for his drawing.

References