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Clinical Impact of Emergency Ultrasound by Emergency Physicians after Implementation in a Hospital in the Netherlands

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Abstract

Although commonly performed in modern medicine, emergency ultrasound utilization by emergency physicians themselves is not common practise in The Netherlands, although the characteristics of critical care patients are the same worldwide. This article describes the impact of implementation of ultrasound on treatment of acutely ill patients. All ultrasound exams performed by the author during the first year after implementation are analysed and categorised according to the level of attribution to the diagnostic and therapeutic process.

On a total of 122 ultrasound exams on critical care patients, 27% of cases directly influenced the medical process and guided medical treatment. 91% of positive results were correct after comparison with final diagnosis at discharge or cause of death. In conclusion, emergency ultrasound by qualified emergency physicians is safe and effective in critical care.

Keywords: Emergency ultrasound; Diagnostic process; Critical care; Emergency department logistics

In the Netherlands, emergency ultrasound examinations performed by emergency physicians is a relatively new tool in critical emergency care. It is considered very common in other civilized countries [2], but oddly enough only a handfull of all 105 emergency departments in The Netherlands use ultrasound by qualified emergency physicians in patient care. Furthermore, these ultrasound examintions are only employed if indicated by the presenting complaints or clinical signs and symptoms, as presented in Table 1.

Introduction

This article describes the impact of ultrasound examination on the treatment of acutely ill patients in the first year after implementation of a ultrasound machine [1] in an emergency department not utilizing ultrasound by emergency physicians previously.

Cardiac (peri-)arrest	Absent myocardial activity
(cardiac evaluation)	Diminished left ventricular function
	Pericardial effusion
	Enlarged right ventricle
Dyspnea	Abnormality at cardiac evaluation (as above)
	Absent lung sliding sign
	Pleural effusion
	A-line or B-line pulmonary predominance
Hypotensive shock	Abnormality at cardiac evaluation (as above)
	Abnormal caval index
	Abdominal aortic aneurysm
	Free abdominal fluid
Abdominal trauma	Free abdominal fluid
Ectopic pregnancy	Free abdominal fluid
	Intra uterine pregnancy with beating heart sign

Urolithiasis	Hydronefrosis

Table 1: Indications for emergency ultrasound examination and pathologic findings

Many serious illnesses and possible lethal diseases can present themselves with non specific signs and symptoms [3]. Being able to look at the patient from a different view, to visualise the inside of the patient, can help emergency physicians to literally change their view and identify ominous pathologies before they cause serious harm [4].

Methods

From December 2012 through November 2013 all ultrasound examinations performed by the author were analysed and reported. As advocated in most ultrasound protocols multiple sets of ultrasound examinations were combined for maximal outcome. All coincidental findings were documented. Final diagnosis at emergency discharge or hospital discharge or the cause of death was compared to the findings in positive ultrasound exams in order to asses the accuracy of ultrasound interpretation. The impact on patient treatment was estimated and categorised as: 1. Leading in determining the next step in medical treatment. 2. Significantly informative and/or strongly suggestive for particular diagnosis and 3. Negative ultrasound findings for narrowing down differential diagnosis.

Results

During the investigated period the author performed 122 ultrasound exams on 122 critical care patients in 146 shifts. Ten ultrasound exams (8% of total) were performed on patients at (peri)cardiac arrest. Forty percent of these examinations (4/10) showed a complete cardiac standstill and were categorised as leading in determining the next step in resuscitation, namely to stop resuscitation efforts. Two of the cardiac arrest ultrasound cases were significantly informative on suspected etiology, namely one enlarged right ventrical suggesting pulmonary embolism and the other revealing pericardial effusion as cause of the cardiac arrest. In 40% of cases the ultrasound examination was not suggestive towards a definite diagnosis, but was helpful in eliminating possible causes of cardiac arrest.

On a total of 112 non cardiac arrest ultrasound examinations, 4% (5/112) directly determined the etiology of the presenting complaint and guided medical workup. Exemplar findings were seriously diminished left ventricular function, large abdominal aneurysm, aortic dissection, pericardial effusion and enlarged right ventricle. 20% (23/112) of cases provided strong suggestive evidence for the supposed diagnosis. Examples include B-line predominance and shortness of breath, collapsing caval vein and a hyperdynamic heart in hypotensive shock, severe hydronefrosis in flank pain by urolithiasis and anterior pneumothorax in thoracic trauma. 72% (81/112) of examinations were interpreted as normal and thus eliminated possible diagnosis. In 2% (4/122) of all cases a coincidental finding was encountered.

91% (31/34) of positive ultrasound examinations were correctly interpreted. Amongst the incorrect interpretations was one case of pneumothorax, in which a computerized tomografie scan ruled it out and one left ventricular function assessed as too low, thus withholding fluids to a patient with non cardiogenic shock till the error was objectified otherwise. The third case was a hydronefrosis finding that the urologists ultrasound countered.

Discussion

Emergency ultrasound, if performed by experienced personnel, can provide information leading to proper treatment of emergency patients [5]. Analysing the results above, one can conclude that emergency ultrasound performed by emergency physicians is a valuable and safe asset in quickly determining diagnosis and starting definitive treatment for patients in dutch emergency departments. Furthermore, if emergency physicians start doing their own ultrasound exams on critical patients, the quality and speed of patient care could improve, possibly resulting in lower costs for unneccesary additional investigations and possibly resulting in better throughput numbers of the emergency department, thereby increasing time efficiency.

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The classification used to categorise ultrasound exams is subjective, because of a lack of usefull classification systems in medical literature. This could hinder interpretation and correlation of the results with published research.

It is questionable if patients' outcome would have differed if ultrasound hadn't been used. This is because, arguably, the same diagnosis could be made with less diagnostic information. However, emergency ultrasound results are available early on in the diagnostic process and provides timely clues when dealing with acute diagnostic challenges [6].

Finally, the ultrasound examinations interpreted as normal could have been unnecessarily performed and time consuming as well and this might reflect an aspect of cost and time inefficiency. But questioning the relevance of ultrasound at that time can only be quantified in retrospect, as is the case in most diagnostic and therapeutic steps in all fields of modern medicine. This theory can never be an argument for not using emergency ultrasound in critical care.

Conclusion

In the Netherlands, emergency ultrasound examination performed by emergency physicians is safe for patients and possibly time-effective in resuscitation and treatment of detrimental clinical presentations. In one year's time a vast array of pathological ultrasonographic findings are encountered, thus boosting the experience and confidence of beginning sonographers. Most importantly, ultrasound can provide clues that emergency physicians need to treat critical care patients at their best.

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