Injury, Int. J. Care Injured 46 (2015) 2093–2102

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Review

Prehospital ultrasound of the abdomen and thorax changes trauma patient management: A systematic review

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ARTICLE INFO

Article history:
Accepted 2 July 2015

Keywords:
Ultrasound
Prehospital
Systematic review
Sonography
Emergency medical services
Air medical transport
Helicopter
Trauma
FAST
EFAST

ABSTRACT

Background: Ultrasound examination of trauma patients is increasingly performed in prehospital services. It is unclear if prehospital sonographic assessments change patient management: providing prehospital diagnosis and treatment, determining choice of destination hospital, or treatment at the receiving hospital.
Objective: This review aims to assess and grade the evidence that specifically examines whether prehospital ultrasound (PHUS) of the thorax and/or abdomen changes management of the trauma patient.
Methods: A systematic review was conducted of trauma patients who had an ultrasound of the thorax or abdomen performed in the prehospital setting. PubMed, MEDLINE, Web of Science (CINAHL, EMBASE, Cochrane Central Register of Controlled Trials) and the reference lists of included studies were searched. Methodological quality was checked and risk of bias analysis performed, a level of evidence grade was assigned, and descriptive data analysis performed.
Results: 992 unique citations were identified, which included eight studies that met inclusion criteria with a total of 925 patients. There are no reports of randomised controlled trials. Heterogeneity exists between the included studies which ranged from a case series to retrospective and prospective non-randomised observational studies. Three studies achieved a 2+ Scottish Intercollegiate Guidelines Networks grade for quality of evidence and the remainder demonstrated a high risk of bias. The three best studies each provided examples of prehospital ultrasound positively changing patient management.
Conclusion: There is moderate evidence that supports prehospital physician use of ultrasound for trauma patients. For some patients, management was changed based on the results of the PHUS. The benefit of ultrasound use in non-physician services is unclear.

Contents

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http://dx.doi.org/10.1016/j.injury.2015.07.007
0020–1383/

Introduction

Ultrasound has been used to assess injured patients in hospital emergency settings for over twenty years [1–3] where it is considered an integral part of the physical exam, similar to stethoscope use [4,5]. The use of ultrasound is considered a class-one recommendation for in-hospital assessment of trauma patients for potential haemorrhage [6], with decreased time to surgery and reduced hospital length of stay [7]. It may also reduce mortality [8].

The idea of using ultrasound in prehospital settings was suggested over thirty years ago [9] but the devices of the time were not suited to the out-of-hospital environment. Improved equipment allowed prehospital ultrasound (PHUS) to be introduced [10]. In 1998 in a remote desert environment PHUS was reported to be feasible as well as able to provide early diagnosis of haemothorax, pneumothorax, haemopericardium, and haemoperitoneum [11]. In the early-to-mid 2000's PHUS was introduced to various prehospital services in Europe, Australia, and North America. In all of the different ground and helicopter emergency medical services (HEMS) studied, PHUS was found to be feasible [12–17].

Though PHUS has been used for more than a decade, its use is not widespread. A recent French study found that PHUS was only available in 9% of French emergency medical service (EMS) units [18]. A survey of EMS medical directors in the USA and Canada found that PHUS was used in only 4.1% of services, but that a further 21% of services were considering implementing it [19]. Reasons cited for why PHUS is not more widely used include the cost of equipment and training, inadequate time to conduct a PHUS due to short transport times [19], and a lack of evidence of benefit [18,19]. Jorgensen et al. [20] concluded that there was insufficient evidence to demonstrate that PHUS of the abdomen and chest improves treatment of trauma. This review was cited in the 2013 European guidelines which stated that there was no evidence that PHUS of the abdomen or chest improved trauma-patient treatment, though there was class-one evidence to support in-hospital use [6]. PHUS has been identified as one of the top five research priorities in physician-staffed prehospital critical care [21].

Objectives

There is inadequate evidence to assess the effect of PHUS on trauma-patient morbidity and mortality, though recent studies do suggest that PHUS can optimise treatment and change the management of the trauma patient. The goal of this review was to systematically review and grade this new evidence along with previously published evidence. The primary outcome examined was whether PHUS of the thorax or abdomen changed trauma-patient management, either through changed diagnosis, prehospital treatment, choice of destination hospital, or hospital response; for trauma patients of all ages. The secondary outcome was to determine if there were complications or harm associated with PHUS.

Methods

Protocol and registration

A protocol was developed using the guidelines of the *Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)* [22] and it was registered in the PROSPERO database (CRD:42014013935, www.crd.york.ac.uk/prospero), prior to conducting the search.

Eligibility criteria

Eligible studies included trauma patients of any age who had a PHUS scan of the thorax or abdomen. Studies selected for further assessment were peer reviewed, full text, English language, and included randomised and non-randomised interventional studies, controlled and non-controlled observational studies, and case series.

Information sources

Systematic searches were conducted for the period from January 1, 1990 to September 27, 2014. The use of PHUS prior to 1996 was thought to be unlikely as the portability of the devices precluded its use however the search was performed to 1990 to ensure that no early studies were missed. Two medical librarian assisted database searches were conducted of: The US National Library of Medicine (PubMed) and MEDLINE (OVID SP). Additionally the ISI Web of Science: Science Citation Index Expanded (SCIEXPANDED), Pubmed Central, Google Scholar, and BioMed Central were also searched for articles that cited a study included in this review. The reference lists of identified studies and relevant systematic and non-systematic reviews were reviewed for additional relevant studies. Several study authors were contacted to identify any missed articles.

Search strategy

The search was conducted independently by the researchers on March 20, 2014 and September 30, 2014 using the search strategies detailed in Appendix 1.