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Clinical Scenario

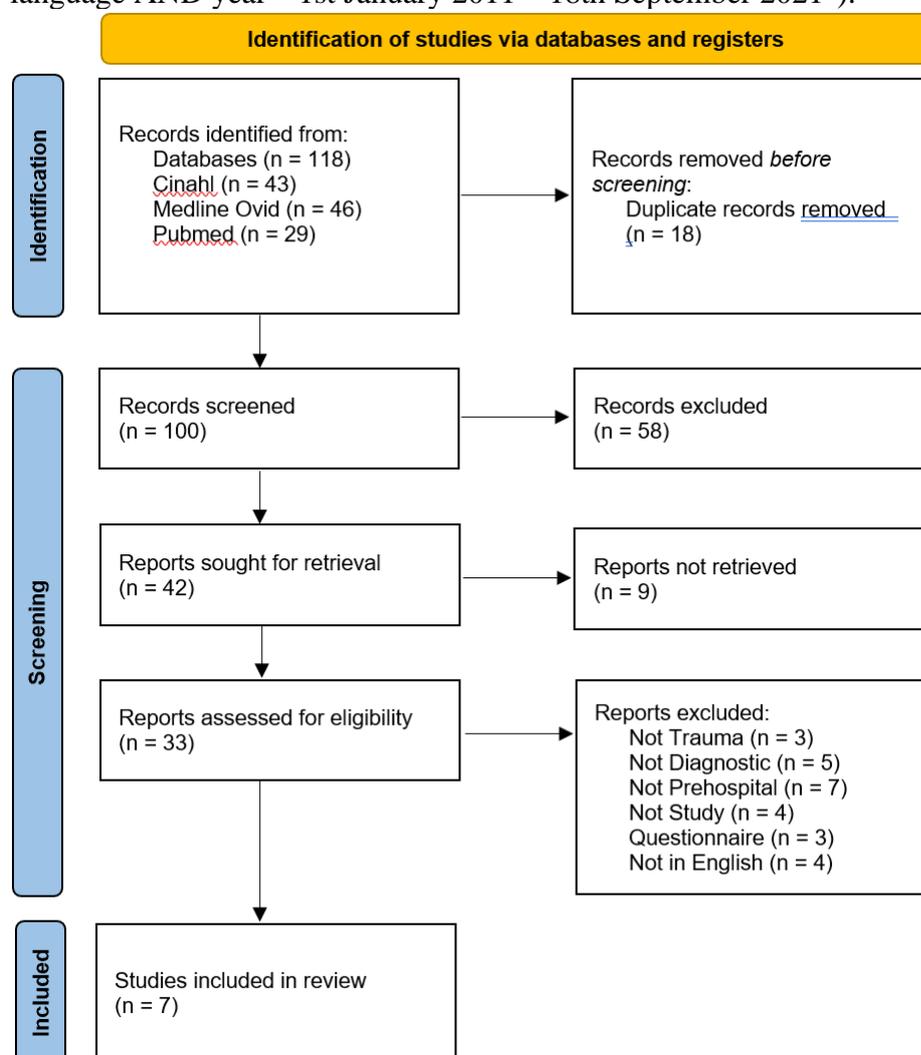
A paramedic is called to a conscious patient involved in a motorcycle crash where they sustained injury to their abdominal and pelvic regions. The top differential diagnoses for the patient is abdominal contusion, perforated bowel and haemoperitoneum.

PICO (Population-Intervention-Comparison-Outcome) Question

For prehospital trauma patients, is POCUS effective in diagnosing abdominopelvic trauma.

Search Strategy

(POCUS OR Ultrasound) AND (Paramedic* OR Prehospital OR pre-hospital OR Ambulance OR "out of hospital" OR EMS OR "emergency medical service") AND (abdominopelvic OR abdomen OR abdominal OR pelvic OR pelvis) limit to (English language AND year="1st January 2011 – 18th September 2021").



Relevance and Rationale of the Question

Due to the number of different organs and structures located in the abdominopelvic compartment, it is difficult to diagnose specific organ injury in the setting of trauma. This if

further compounded by the fact that paramedics are limited in their option for patient diagnostic imaging. Ultrasound has been found to be a simple, portable, and inexpensive method of generating images of diagnostic quality for internal abdominopelvic injury. The PICO question is important to examine as POCUS is underutilised in the prehospital setting,

Relevant Papers

Author and Year	Study Design (LOE)	Population: Sample and Characteristics	Aim	Results	Strengths and Limitations
O'Dochartaigh & Douma, 2015	Systematic Review LOE 2	Eight studies from 2006 to 2013 were identified.	To review evidence that examines whether PHUS of the thorax/abdomen changes trauma patient management.	<ul style="list-style-type: none"> - The review identified that PHUS changes trauma patient management through improvement in prehospital diagnosis and treatment, choice of referral hospital and receiving hospital response. - Identifying internal injury is a challenge in prehospital care. - PHUS is especially effective when physical exam is indeterminate. - It is important that PHUS does not interfere with patient care. 	<p>Strengths</p> <ul style="list-style-type: none"> - Systematic review of eight studies. <p>Limitations</p> <ul style="list-style-type: none"> - Low quality of evidence. - Low number of patients in studies. - No control group.
Press et al, 2014	Prospective observational study LOE 2	293 trauma patients aged 18 years and older. No other details on patient condition where provided.	To determine the accuracy of PHUS for trauma patients by HEMS.	<ul style="list-style-type: none"> - 32% of assessment images interpreted as indeterminate. - HEMS PHUS was more sensitive for haemoperitoneum requiring operation than haemoperitoneum alone. - Positive interpretations were correct in 52.7% cases. 	<p>Strengths</p> <ul style="list-style-type: none"> - Included details on patients requiring imagery and surgery to determine trauma. <p>Limitations</p> <ul style="list-style-type: none"> - Single institution with one HEMS crew.

				<ul style="list-style-type: none"> - Low sensitivity, high specificity. - PHUS was more effective than auscultation in helicopters, where noise is a factor. 	<ul style="list-style-type: none"> - Study design limited sample size.
Snaith et al, 2011	Experimental repeatability study LOE 3	36 FAST examinations performed by 4 physicians on 2 healthy individuals.	To compare PHUS to ED ultrasound examination to determine the feasibility of PHUS.	<ul style="list-style-type: none"> - Ultrasound examinations can be performed in moving land ambulances to a standard consistent with EDs. - Examinations in moving ambulance take longer than stationary vehicle. - Environment has little effect on ultrasound imaging. - Ultrasound is dynamic, requiring constant re-evaluation. 	<p>Strengths</p> <ul style="list-style-type: none"> - Compares PHUS to examinations completed in EDs. - Compares different environment in which EMS work. <p>Limitations</p> <ul style="list-style-type: none"> - Examination conducted by emergency physicians and sonographers rather than paramedics. - Small sample size and only two healthy patients.
van der Weide et al, 2019	Systematic Review LOE	Nine studies from 2001 to 2018 were identified.	To evaluate current evidence regarding accuracy and effect of PHUS on trauma patient management.	<ul style="list-style-type: none"> - PHUS led to a change in management in five out of nine studies, in which alteration of management was prohibited in three articles. - Accuracy was considered to be adequate in eight studies. - PHUS examination is more difficult than examination in EDs 	<p>Strengths</p> <ul style="list-style-type: none"> - Thorough search strategy. <p>Limitations</p> <ul style="list-style-type: none"> - Different patient populations between the studies.

				<ul style="list-style-type: none"> - Obesity complicates imaging - Ability depends on skill and experience, complicating study - Time taken performing PHUS can hinder treatment. 	
West et al, 2014	Single-blinded RCT LOE 1	90 examinations conducted by nine Paramedics on 10 randomised simulated patients.	To determine the effectiveness of PHUS in triage of trauma MCIs patients by paramedics.	<ul style="list-style-type: none"> - Paramedics had difficulty performing FAST examinations with a high degree of accuracy. - Paramedics were more likely to interpret examination as positive. - Recently taught paramedics may quickly lose ability if untrained. - 	<p>Strengths</p> <ul style="list-style-type: none"> - Single-blinded RCT <p>Limitations</p> <ul style="list-style-type: none"> - Study patients and environment was simulated. - Small sample size
Waterman et al, 2020	Prospective observational double-blinded study LOE 2	Ultrasound examination of 5 healthy volunteers by 14 critical care paramedics with at least one year of experience compared with four emergency physicians	To determine whether paramedics can generate adequate POCUS images compared to emergency physicians	<ul style="list-style-type: none"> - Paramedics were not able to interpretable images at the same frequency as emergency physicians. - Paramedics had a 61% usable image rate, which is promising for further study. 	<p>Strengths</p> <ul style="list-style-type: none"> - Compares paramedics ability to generate images compared to emergency physicians <p>Limitations</p> <ul style="list-style-type: none"> - Small sample size. - Healthy patients. - Not in time sensitive situation/trauma scenario.

Waterman, Tien et al, 2020	Prospective observational study LOE 2	14 critical care paramedics and four emergency physicians	To determine whether paramedics can interpret FAST images as well as emergency physicians	- CCPs were able to use ultrasound to detect free fluid in simulated mannequin models and interpret FAST exams with a similar accuracy to emergency physicians.	<p>Strengths</p> <ul style="list-style-type: none"> - Compared both paramedic examination and interpretation of ultrasound with emergency physicians <p>Limitations</p> <ul style="list-style-type: none"> - Simulated environment and mannequin patients. - Small sample size.
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Abbreviations: CCP; Critical care paramedic, ED; Emergency department, EMS; Emergency medical services, FAST; Focused assessment with sonography for trauma, HEMS; Helicopter emergency medical services, LOE; Level of evidence, MCI; Mass-casualty incident PHUS; Prehospital ultrasound, POCUS; Point of care ultrasound, RCT; Randomised control trial.

Comments

POCUS has been a common topic of study over the last 10 years, though few large-scale, high-quality studies exist on its application in trauma by paramedics. Most studies were experimental and performed in a controlled or simulated environment, often with healthy volunteers as 'patients'. Most studies found that paramedics were capable of generating interpretable ultrasound imagery at a rate of around 50%. Waterman, Tien et al found that critical care paramedics were comparable to emergency physicians in their ability to interpret ultrasound examinations and diagnoses haemoperitoneum (2020). All studies showed that POCUS was effective for paramedics in diagnosing abdominopelvic trauma. The relevant studies identified that POCUS was effective in diagnosing free fluid in the peritoneum, but no studies identified if the source of the fluid could be found by ultrasound. To be able to identify which organ is injured will assist in diagnosis and treatment of the patient's condition. Several studies noted that POCUS may delay time for treatment. Further study should identify how the change in patient management as a result of ultrasound examination affects patient outcomes, such as 30-day mortality and hospital length of stay.

Consider

Based on the relevant articles a change in practice is recommended. All paramedics should be trained to be able to use ultrasound for abdominopelvic imaging. An appropriate clinical practice procedure should be developed for the application of focused assessment with sonography for trauma (FAST) examination. This protocol should reduce time taken to generate essential images of diagnostic quality, and define specific regions for imaging. Further observational studies should be conducted comparing prehospital and in hospital

diagnosis, before and after ultrasound examination, along with changes in patient outcome as a result of change of treatment after examination.

Clinical Bottom Line

Point of care ultrasound performed by paramedics has been shown in several studies to be effective in diagnosing abdominopelvic trauma, though not as accurate as sonography performed by hospital physicians. In the future, all paramedics should be trained to use ultrasound in accordance with service protocol in order to further study its impact on trauma diagnosis.

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