

Point-of Care-Ultrasound by Military Clinicians: A Review of the Literature

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Background

- Ultrasound (US) has long been used for trauma assessment in the initial evaluation of patients with suspected blunt trauma.
- US technology has the potential to improve diagnostic accuracy and enhance patient care in the prehospital austere setting.
- Emergency ultrasound is not meant to replace a thorough history and exam, but to quickly answer specific questions and support decision making.
- US devices have evolved over time and continue to get smaller, lighter, more portable, and more durable.

Objective

- The purpose of this project was to report data related to the use of point-of-care US (POCUS) by military clinicians and to describe specific ultrasound devices.

Methods

- Databases searched: PubMed, Cochrane, Scopus, Web of Science, Defense Technical Info. Center
- Keywords: military, ultrasound
- Inclusion Criteria: Use of ultrasound by military clinicians with report of sensitivity/specificity, accuracy of exam and/or clinical decision impact

Results

Table 1. Military Studies

Study #	Device	Sample	Training	Results
1	SonoSite M-Turbo	28 Army medics	1-hour didactic & 1-hour hands-on training, used chicken model (chicken thigh in surgical glove), each medic was presented with 20 randomized models.	• Sensitivity 73% • Specificity 78%
2	Not specified	32 Army Combat medics	15-minute lecture on transtracheal US techniques, followed by hands-on practice	• Sensitivity 66.7% • Specificity 76.4%
3	Not specified	12 Army National Guard combat medics	5-minute lecture and brief hands-on training.	• 44 of 48 exams accurately documented presences of cardiac activity.
4	SonoSite M-Turbo	20 18Ds	3-minute orientation & training.	• Sensitivity 100% • Specificity 90%
5	Not specified	29 18Ds	16.7 hours training on average using SOLCUS outline. Included FAST exam, pneumothorax detection & musculoskeletal exam.	• 4 fracture cases presented – 100% were correctly diagnosed and confirmed by x-ray.
6	SonoSite Vet*	22 physician assistants, SOFs and conventional force medics, veterinary technicians, and food service inspectors	10-minute slide show training & orientation to US machine.	• Sensitivity 95.5% • Specificity 100%
7	FuKuda Denshi USA Device	34 Conventional US Army medics naïve to US	1) 90-minute classroom didactic & 150-minute hands-on scanning instruction (n=19) 2) 90-minute video from SonoSim & 150-minutes hands-on scanning instruction (n=15)	• There was no statically significant difference between knowledge, technical performance, or diagnostic accuracy between medic groups.
8	SonoSite M-Turbo	2 military medicine residents in a French Army teaching hospital	90-minute theoretical and practical (10 US in healthy students, 50 US in patients with symptoms, observed by trainer) US training focused on the gall bladder, kidney & upper urinary tract & the deep venous network of the lower extremities.	• 48 patients had ultrasounds, 18 gall-bladder, 16 renal, 14 lower extremity. • POCUS improved diagnostic accuracy in 73% of cases, was misleading in 2% and did not contribute to 25%.
9	SonoSite 4-6 MHz	3 consultant radiologists, deployed to the Role 3 MTF, Camp Bastion Jan. - May 2014.	N/A – Retrospective review	• Sensitivity 75% • Specificity 99.3% • Overall accuracy 94.7% • ID of intraperitoneal free fluid - PPV 96.2% & NPV 94.4%
10	SonoSite M-Turbo	Consultant radiologist at a Role 2 MTF - Op TRENTON 3	N/A – prospective questionnaire study aimed to assess usefulness of diagnostic US in Role 2 setting.	• US increased diagnostic confidence in 68% cases and led to a change in patient management for 29% cases. • 3% had no clinical impact.
11	GE Vscan	15 trainee doctors during French pre-deployment simulation training	• MEDICHOS (medical courses in hostile environments) internship • 2-hour training on the use of the Vscan & US devices were provided, trainees to use their discretion.	• eFAST or POCUS exams performed on 26% simulated patients. • 51% of US cases had a significant impact of therapeutic and evacuation priorities • Changed 67% of therapeutic decisions and 72% of evacuation priorities

Note. *SonoSite180plus equivalent; SOLCUS = Special Operators Clinical Level Ultrasound ; FAST = Focused Assessment of Sonography for Trauma; PPV = positive positive value; NPV = negative positive value.

Limitations

- A portion of military studies did not specify the US device used and limit the ability to assess utility of specific devices.
- Patient outcome data was not well described.
- Conclusions drawn form studies are limited due to small samples.



A. GE Healthcare V-Scan Extend



B. SonoSite iViz



C. Phillips Lumify



D. Butterfly iQ



E. Clarius C3 Convex

Table 2. Portable Handheld Devices

Model	Features	Size	Weight	Transducers
GE Healthcare Vscan Extend	• Handheld device with dual-headed probe • store images through Wi-Fi or USB • 60-minute continuous scanning on full charge • online apps available to augment studies • educational videos available • requires gel	Device: 17 · 7.8 · 2.1 cm Dual Probe: 12.9 · 3.9 · 2.8 cm	Device: 365 g Dual probe: 120 g Sector probe: 85g Main unit with Dual probe: 400g	Two transducers in one probe: linear and sector
SonoSite iViz	• Aircraft aluminum tablet with multiple transducers • 64 GB flash drive & cloud storage • Three swappable batteries each with 1-hour continuous scan time • Embedded educational tools • Requires gel • Can be dropped up to 3 feet; IPX-7 rated – fully submergible in water	Tablet: 18.3 · 11.7 · 2.7 cm	Tablet: 570 g	Curved C60v, Linear L25v, Linear L38v, Phased P21v
Philips Lumify	• Transducers attach to Android devices • Uses tablet as a power source - battery life depends on attached device • requires gel • How-to videos available	Curved transducer: 4.5 · 11.4 cm	Curved transducer: 136 g	Linear L12–4, Curved C5–2, Phased S4–1
Butterfly iQ	• Transducer attaches to Apple mobile devices • unlimited cloud storage • Built-in battery; wireless charging • Does not use Piezo crystal technology; 2 hours of continuous scanning on full charge • No gel required • Anodized aluminum body; thermally efficient • Educational videos available	Transducer: 18.5 · 5.6 · 3.5 cm	Transducer: 313 g	Single transducer emulates any kind of transducer
Clarius C3 Convex	• Handheld device – 3 probes-in-1 for iOS and Android. • 60 min battery power, 3 swappable batteries • App based, wireless, does not require internet access to operate. • Magnesium shell, waterproof & withstands drops up to 1 meter • Educational videos available	Device: 16.7 · 9.9 · 4.2 cm	Device: 540 g	Three clip-on tips to scan entire body

Note. Adapted from Canepa and Harris (2019)

Conclusions

- The body of evidence related to the use of POCUS by military medics is limited but provides proof of concept.
- More research with larger sample sizes and evaluation of patient outcomes is needed.

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