

Comparison of Handheld Ultrasound Devices used in Carotid and Abdominal Aortic Vascular Studies

Ali Hakimi BS, Ann Mackey BS, Arman Saeedi BS MPH, Ilana Kafer MD, Max Wohlaer MD, Juliana Wilson DO MPH
University of Colorado Anschutz School of Medicine



University of Colorado
Anschutz Medical Campus

Background

Point-of-Care Ultrasound (POCUS) has become common in many clinical care settings. Many devices exist with several different, mostly overlapping functions. This study is one of the first studies to compare the image quality of commercially available handheld POCUS devices, their potential role in vascular ultrasound and educational utility.

Methods

A prospective study was conducted to evaluate the image quality and clinical utility of the Butterfly IQ, GE Vscan Air, Phillips L12-4 (Linear), and Phillips S4-1 (Phased array) transducers. Twenty-five healthy subjects underwent carotid and abdominal aortic ultrasound examinations with all three applicable devices. An expert panel of reviewers including a radiologist examined the compiled images and answered a survey-based questionnaire including numerical scores and Likert scale assessments to grade the studies on criteria including imaging quality, clinical utility, and educational value.

Transducers Tested



Results

Twenty-five subjects were enrolled in the study. The mean age of study participants was 27.30 years old. 52% identified as female, and 48% identified as male. 8% reported relevant prior medical or surgical history. When scored on a 0-10 Likert scale, examinations performed with the GE Vscan Air resulted in comparatively higher quality studies for both the carotid (5.24, $p = 0.03$) and aortic (4.91, $p = 0.04$) protocols when compared to the Butterfly IQ+ and Lumify devices. All devices scored favorably for educational value with no statistical preference for transducer, $\chi^2(2, N = 122) = 4.75, p = 0.09$.

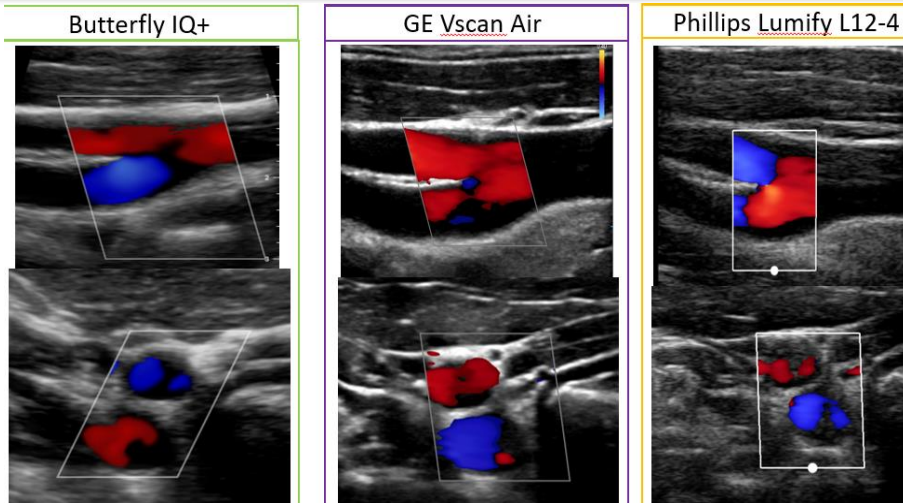


Figure 1: Sample longitudinal (top row) and transverse (bottom row) carotid ultrasound studies from the same subject using the Butterfly IQ+, GE Vscan Air, and Phillips L12-4 transducers.

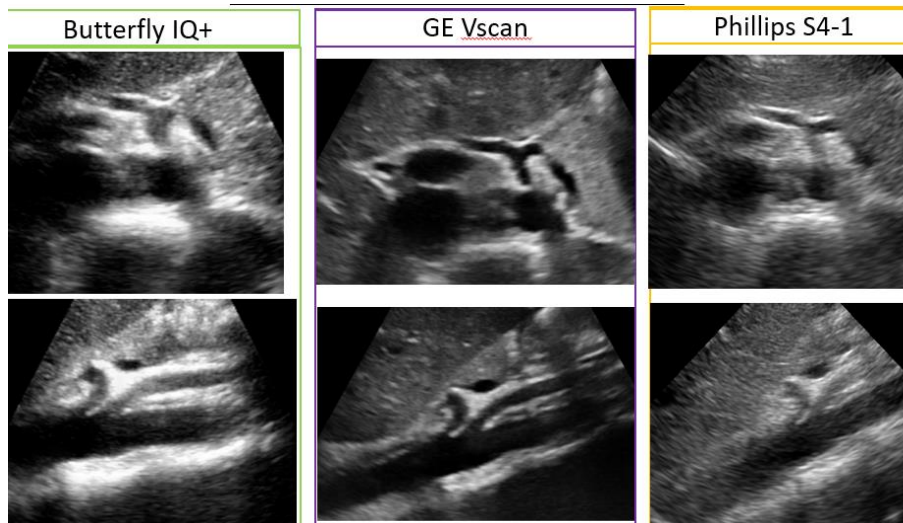


Figure 2: Sample transverse (top row) and longitudinal (bottom row) ultrasound studies from the same subject using the Butterfly IQ+, GE Vscan Air, and Phillips S4-1 transducers.

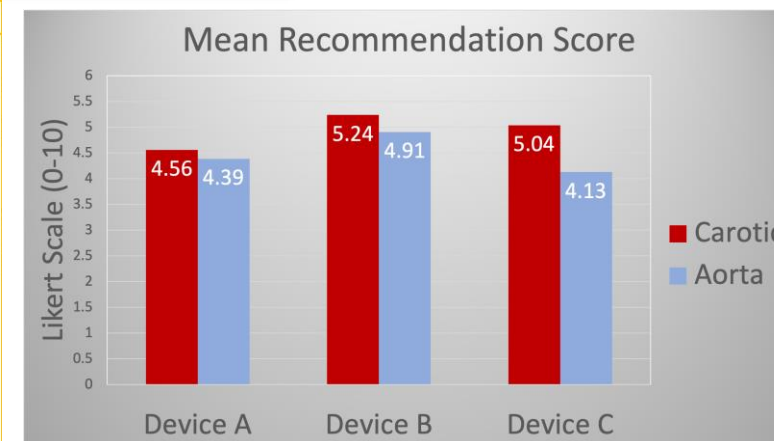


Figure 3: Mean score for quality of the study produced by each device p for carotid = 0.03 for aorta 0.04. Device A = Butterfly IQ+, Device B = GE Vscan Air, Device C/D = Phillips Lumify L12-4/S4-1

Discussion/Limitations

- Although the GE Vscan Air resulted in statistically significant and higher recommendation scores, all three device groups globally scored low on recommendability
- Despite lacking statistical difference between transducers, reviewers did support use of the tested handheld devices for educational purposes.
- Sonographers were not registered vascular technologists
- Results underpowered due to limited data and single-rater bias
- Use of healthy participants may limit external validity
- No comparisons with gold standard vascular laboratory imaging

Conclusion

- Despite the variety of commercially available POCUS devices, further studies are needed to compare the quality and utility of these devices in vascular ultrasound

References

1. Wilkinson JN and Saxhaug LM. Handheld ultrasound in training - The future is getting smaller! J Intensive Care Soc 2021; 22: 220-229. 20200415. DOI: 10.1177/1751143720914216.
2. Dewar ZE, Wu J, Hughes H, et al. A comparison of handheld ultrasound versus traditional ultrasound for the acquisition of RUSH views in healthy volunteers. J Am Coll Emerg Physicians Open 2020; 1: 1320-1325. 202014121. DOI: 10.1002/emp2.12322.