Cardiac Collaboration Project: How Does Emergency Department Cardiac POCUS Stack Up Against Formal Cardiology Echocardiogram?

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Introduction

The Cardiac Collaboration Project is an overarching database used for multiple studies aimed at evaluating and determining the efficacy of cardiac point of care ultrasound (POCUS) in the emergency department (ED). The database includes greater than 1,200 cases of ED cardiac POCUS; however, data collection has not yet been completed. This study compares ED cardiac POCUS interpretation to formal cardiology echocardiogram (echo). The main uses of cardiac POCUS in the ED include assessment of left ventricular ejection fraction (LVEF), fluid status, aortic aneurysm and dissection, and pericardial effusion.[1,2] One study suggests that POCUS decreases time to treatment for LV dysfunction by 18 hours.[1] Paired studies of cardiac POCUS (performed by trainees in the medical ICU) versus echo performed within 24 hours have shown that POCUS may reliably diagnose RV and LV dysfunction and pericardial effusion.3

Methods

The Cardiac Collaboration Project database has been created by identifying all SBUH ED cardiac POCUS from 1/1/2022 through 12/31/2022. Each case was de-identified with a study ID number. Research personnel reviewed each case and input key demographics, findings, relevant testing, and final results into the research database REDCap. 720 of the cases transferred into the database to date had both ED cardiac POCUS and formal cardiac echo performed. Initial data collection did not include congruency of (agreement between) ED POCUS and formal echo. This question was added during the data collection middle stages. If the ED cardiac POCUS and formal echo were not congruent, researchers were asked to describe the differences. Of the 720 cases with both ED cardiac POCUS and formal cardiac echo performed, 47 had congruency analysis performed; these were analyzed for congruency and, if incongruent, what were the differences in interpretation.

Results

To date, 47 cases have been compared for ED cardiac POCUS vs formal echo results.

- 36 (77%) were deemed congruent
- 11 (23%) were deemed incongruent (all but one were discussed/evaluated in the standard QA/QI ultrasound meeting)
  - ED underestimation of EF – 4/11 (36%)
  - ED overestimation of EF – 2/11 (18%)
  - ED overestimation of diastolic function – 1/11 (9%)
  - ED hyperdynamic LV but normal reading on formal echo – 2/11 (18%)
  - Evidence of HOCM on formal echo, not mentioned in ED echo – 1/11 (9%)
  - ED irregular rhythm with normal rhythm on formal echo – 1/11 (9%)

Results

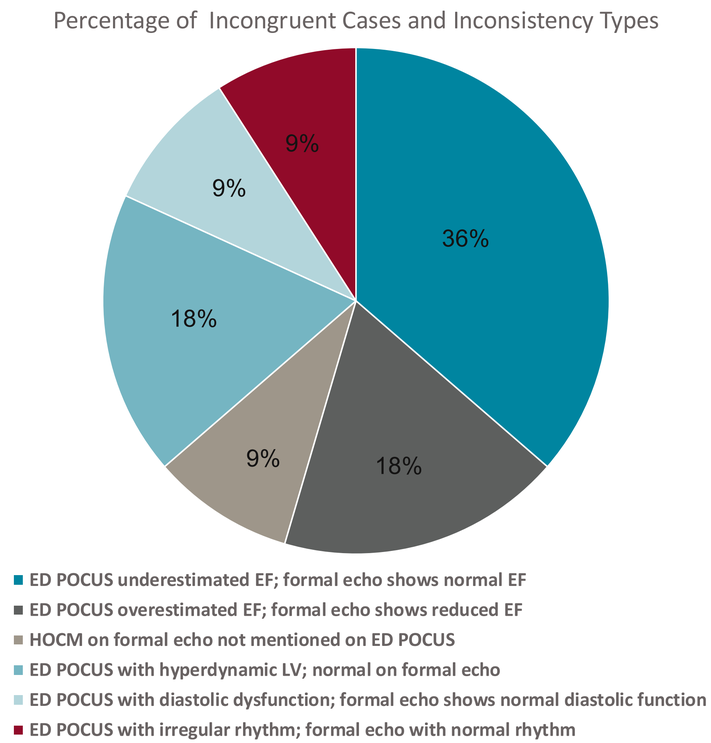

Figure 1. Pie chart demonstrating the percentages of various causes of incongruency between ED cardiac POCUS and formal echo.

Type of QA Result	Number of Results
TN (true negative)	6
FP (false positive)	3
FN (false negative)	1
Not done	1

Table 1. QA results of incongruent ED cardiac POCUS and formal echo by category.

The studies were reviewed during the standard ultrasound division Quality Assurance meeting. The QA team determined that there were 6/10 true negative results, 3/10 false positive results, and 1/10 false negative results. All three false positive results were due to an underestimation of EF (ED team interpreted EF as reduced when truly normal). The one identified false negative result was due to failure of ED interpretation to recognize reduced EF. The case not reviewed by QA team demonstrated on formal echo severely thickened ventricular walls and other concerning findings for HOCM, a potentially deadly diagnosis; these findings were not mentioned on ED interpretation.

Discussion

When comparing ED POCUS to formal echo, 36 of 47 studies were congruent with ED interpretation.

ED cardiac POCUS interpretation can vary based on many different factors.

- Body habitus and lung air artifact may limit the quality of views obtained.
- ED POCUS is also often used to answer a specific question such as "Is there cardiac tamponade?" or "Is the IVC normal sized and collapsible?". There is a possibility that the interpreter may overlook other aspects of the cardiac echo in this case, whereas formal echo is performed in a systematic manner.
- Time constraint may also play a role, as ED physicians are often interrupted during their studies to address other pressing issues or tend to other patients. Echo technicians are able to spend more time with the patients to obtain quality images, and cardiologists interpreting the images are also able to spend more time reviewing the images.
- Year of training and fellowship may also play a role in varying accuracy of interpretations.
- Quality of equipment – ED ultrasounds serve many purposes and must be more mobile/compact, and thus are often of lower quality than those used by echo technicians
- Formal cardiac echo is frequently performed the following day – the patient's physiology may have changed based on interventions performed in between ED POCUS and formal echo such as catheterization, diuresis, fluid resuscitation, inotropic support, etc.

Additional studies may further investigate whether degree of training plays a role in accuracy. The current study is significantly limited due to data size. Completion of the full study database may be analyzed in the future to determine if there is a particular tendency of ED physicians on cardiac POCUS when compared to formal cardiac echo such as over/underestimation of EF.

References

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3. Fox, Steven, et al. “Diagnostic Accuracy of Cardiac Point-of-Care Ultrasound in a Tertiary Medical Intensive Care Unit.” *Critical Care Explorations*, NIH National Library of Medicine, 20 Dec. 2023, pmc.ncbi.nlm.nih.gov/articles/PMC10735065/.