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First do no harm: echocardiography during cardiac arrest may increase pulse check duration

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Use of point-of-care cardiac ultrasound (POCUS) for evaluation of the critically ill has increased dramatically in the past 10–15 years, including in patients receiving CPR.[1] The hypothesized utility of POCUS during cardiac arrest resuscitation lies in its ability to identify otherwise occult etiologies of arrest (e.g. cardiac tamponade or massive pulmonary embolism), an ability borne out in several small observational studies. [2–5] POCUS may also have prognostic value when able to differentiate cardiac standstill from electromechanical dissociation, with several prior investigators reporting a strong association between cardiac standstill and mortality.[6–8] The literature on this topic however is overwhelmingly characterized by small observational studies and case series, limiting the conclusions that can be drawn.

The need for further research on the utility of POCUS during cardiac arrest is highlighted by the most recent evidence review conducted by ILCOR in 2015 to answer the question of whether POCUS during cardiac arrest improved ROSC or survival rates. The literature search yielded so few studies that no conclusion could be reached, with only two studies meeting criteria for review.[9, 10] A single randomized trial enrolled 100 patients presenting to the Emergency Department with PEA and randomized them to have ultrasound done during pulse checks or not. They found no difference in rate of ROSC, but were likely not adequately powered to detect such a difference. [11] Prosen *et al* used POCUS in the field to direct the use of vasopressin for pseudo-PEA. They found improved survival with ultrasound use when compared to historical controls, but the study design limits the extent to which causality can be assigned.[12]

With such limited data, the decision of whether to use POCUS during cardiac arrest depends on balancing the answers to three key questions: 1) could it help identify a treatable problem? 2) could it inform whether resuscitative efforts should be stopped and 3) is there any potential harm? Avoiding potential harm when using an unproven intervention is perhaps the most important, and yet this question has been relatively neglected in the available literature.

In the current issue of *Resuscitation*, Dr. Huis 't Veld and colleagues focus on this exact issue and present their findings from a single center observational study looking at the association between POCUS use and the duration of pulse checks during CPR.[13] The study was conducted in their Emergency Department at a major urban academic center in the

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United States. Investigators watched stored videos from continuous monitoring that is automatically conducted in three of their resuscitation rooms. They recorded the duration of each pulse check and whether or not POCUS or any other procedure was attempted during the pulse check. They also recorded whether any procedures or interventions were done as a direct result of the ultrasound. In the 23 patients included, the investigators found that pauses in chest compressions were 8 seconds longer when POCUS was used (21 vs 13 secs, $p<0.0001$). There was a slight trend toward longer pulse checks associated with other procedures (average of 2.9 secs longer, $p=0.08$). They did not observe any procedures or interventions undertaken as a direct result of POCUS findings. On the basis of these results, the authors caution providers to more closely monitor the duration of CPR interruptions when POCUS is being used.

While this study is limited by small size and single center design, nonetheless the investigators have highlighted an important issue that has not been addressed thoroughly in other studies. A study by Hayhurst and colleagues did include this data and found images were obtained in less than 10 seconds in 90% of cases, while Gaspari *et al* reported that POCUS images recorded during CPR were an average length of 4.5 seconds.[5, 14] It is not reported whether pauses in CPR also remained under 10 seconds however. One other study that explicitly looked at “hands off chest time” with POCUS use during cardiac arrest found that pauses were < 10 seconds in only 44% (4/9) cases, with a median pause length of 17 seconds.[15]

A key feature of the present study is that the use of POCUS during CPR was not a protocol designed or administered by the research team, and therefore there was no study-driven training in POCUS use. In much of the prior work, the clinicians performing and interpreting the ultrasound at the bedside have generally been part of the research team or trained by that team. Thus, the procedure is often performed in a protocolized way, with significant attention to not interrupting CPR or lengthening pulse checks, as well as training in what findings to look for that might alter treatment. In the current study, the investigators essentially observed real-world practice. This difference could explain why they found a significant increase in pulse check duration while some prior studies have not. The finding highlights the importance of training clinicians using cardiac ultrasound so that any interruptions in CPR can be avoided. Points to consider in ultrasound protocols, some of which the authors suggest in their discussion, include positioning the probe in the desired position prior to pauses for pulse checks, counting the seconds aloud during image acquisition, recording images for interpretation after CPR is resumed or potentially using transesophageal probes that can be left in place during CPR.

This study also found no instances in which ultrasound findings altered treatment, which also differs from the findings of others.[2–5] The lack of such findings in the current study may be due simply to the small number of patients. It could also again be due to the fact that it was not the research team doing the POCUS, and thus the threshold for deciding that findings were suggestive of massive pulmonary embolism or cardiac tamponade may have been different.

Huis in 't Veld *et al* did not attempt to associate imaging findings with outcome, but this has been done in several observational studies in the past, with multiple research groups reporting a strong association between cardiac standstill and mortality.[3, 5, 7, 8, 16] Some advocate using this to aid decision making, and in one prior work the only way in which POCUS findings altered treatment was in prompting the team to stop CPR when cardiac standstill was seen.[15] A systematic review however injects a note of caution, concluding that cardiac standstill “harbors a significantly lower (but not zero) likelihood that a patient will experience ROSC.” [6] The authors of the review conclude that POCUS can inform prognosis but should not be used in isolation to make decisions on stopping CPR.

This study adds significantly to the small but growing body of literature on POCUS use during cardiac arrest. POCUS is a promising modality that may help identify etiologies of arrest and be useful as one more factor to consider when deciding whether to continue resuscitative efforts. Paramount however should be the prevention of harm by not delaying one of the few treatments we know is beneficial: high quality CPR. If POCUS is to be used, training clinicians to obtain these images without lengthening pauses or otherwise interfering with CPR must be a primary focus, and future studies of POCUS during cardiac arrest should include this variable as an important outcome.

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