Summer 7-15-2022

Considerations of PoCUS vs Manual Pulse Check in Predicting ROSC for Patients Presenting in PEA

Steven M. Shockley
sshockley20@georgefox.edu

Considerations of PoCUS vs Manual Pulse Check in Predicting ROSC for Patients Presenting in PEA

Steven M. Shockley, PA-S

George Fox University

School of Graduate Health Sciences

Department of Physician Assistant Medicine

Doctor of Medical Science Program

Dr. Justin M. Gambini, DMSc, PA-C, DFAAPA

ARP II: Dissertation Manuscript

Scholarly Project: Draft Manuscript

July 15, 2022

TITLE

The title for this scholarly project is: Considerations of PoCUS vs Manual Pulse Check in Predicting ROSC for Patients Presenting in PEA

ABSTRACT

Background: Point of care ultrasound (PoCUS) has enabled providers to draw a contrast between true PEA (Pulseless Electrical Activity) and pseudo-PEA. The incorporation of PoCUS pulse checks in PEA and pseudo-PEA has been shown to more accurately predict Return of Spontaneous Circulation (ROSC) when compared to standard manual pulse checks. However, concerns have been raised in recent observational studies regarding increased duration of PoCUS pulse checks compared to manual pulse checks leading to suboptimal CPR and subsequent deterioration of ACLS protocol integrity.

Objective: This clinical review aims to examine the utility and practical implementation of PoCUS versus manual pulse check in the prediction of ROSC for patients presenting to the hospital in PEA.

Discussion: A PubMed, MEDLINE, Scopus, and CINAHL databases literature search was conducted with the following search terms: point of care ultrasound (PoCUS), pulseless electrical activity (PEA), Pseudo Pulseless Electrical Activity (Pseudo PEA), manual pulse check, Return of Spontaneous Circulation (ROSC)

Conclusions: PoCUS plays in an important role in predicting ROSC for patients presenting in PEA. Given the importance of the distinction between true PEA and pseudo-PEA, the literature suggests implementation of training for providers in expedient and skillful use of PoCUS to identify pseudo-PEA may be beneficial provided that pauses in CPR are not prolonged.

Keywords: point of care ultrasound (PoCUS), pulseless electrical activity (PEA), Pseudo Pulseless Electrical Activity (Pseudo PEA), manual pulse check, Return of Spontaneous Circulation (ROSC)

INTRODUCTION

Pulseless Electrical Activity (PEA) is a heart rhythm which can be characterized by unresponsiveness, impalpable pulse, and absence of cardiac output on ultrasound in the presence of sufficient cardiac electrical discharge.[1] The most common mechanism of this rhythm comes as a result of improper ventricular impulse and subsequent absence of any meaningful ventricular contraction. The incidence of PEA varies among different United States patient populations. PEA accounts for approximately 20% of sudden cardiac deaths outside of the hospital setting.[1] The risk of PEA increases over the age of 70, especially in the female population.[1]

Pseudo-PEA refers to patients with absent pulse, but with evidence of cardiac output through the utilization of bedside echocardiography.[2] Thus, point-of-care echocardiography has enabled us to draw a contrast between pseudo-PEA and true PEA. Distinguishing pseudo-PEA from true PEA is important for emergency physicians as the prognosis and management of these patients differ drastically. In contrast to PEA, which is true absence of perfusion, Pseudo-PEA can be considered a state of profound cardiogenic shock caused by a significant pathological event but which has a potentially “perfusable rhythm”. Common causes of pseudo-PEA include hypovolemia, tachydysrhythmias, decreased cardiac contractility, or obstructions to circulation, such as pulmonary embolism, tamponade, and tension pneumothorax.

Point of Care Ultrasound (PoCUS) is a modality which has seen much more frequent utilization in the past 10 years in the setting of cardiac arrest in order to detect a pulse and to

distinguish between PEA and pseudo-PEA. Incorporation of PoCUS pulse checks with patients presenting in PEA has been shown to more accurately predict Return of Spontaneous Circulation (ROSC) when compared to standard manual pulse checks.[3,4] The presence of ROSC has been well established in the literature as a strong predictor of patient morbidity and mortality. With regards to prognosis, pseudo-PEA is associated with higher rates of ROSC and survival to hospital discharge.[4,5] Identifying patients in pseudo-PEA is critical for accurate management and treatment of a patient and is a crucial factor regarding resuscitation decisions. However, there have been several observational studies showing that PoCUS pulse checks lead to prolonged pauses in chest compressions[6,7], although a recent study showed that with minimal training PoCUS pulse checks are more accurate than manual pulse checks.[8]

While there has been increasing research surrounding PEA and pseudo-PEA in recent years, it remains an important yet understudied component of cardiac arrest. This topic has a profound impact on the healthcare community, as PEA is a frequent finding during cardiac arrest resuscitation. It is clear that the use of PoCUS in the setting of PEA remains controversial in the medical community. This clinical review aims to examine the utility and practical implementation of PoCUS versus manual pulse check during cardiac resuscitation.

DISCUSSION

It has been suggested in the literature[9, 10] that healthcare providers and first responders are generally poor overall at performing manual pulse checks with consistent accuracy. Historically, emergency physicians and first responders relied solely on manual pulse checks to determine if a patient has any meaningful cardiac output, however this method is unreliable due to factors such as anatomical variation, mistaking pulse-of-self as pulse of patient, and varied skill sets or experience. One study of first responders by Eberle B et al[9] showed that of all participants, only

15% (31/206) produced correct diagnoses within 10 s, and just 1/59 (2%) identified pulselessness correctly within 10 seconds. The study also showed that overall rescuer pulse palpation was only 78% accurate.[9] Yet another study of emergency and ICU physicians and nurses attempting manual pulse determination in healthy subjects demonstrated that 43% of participants required more than 5 seconds to detect the pulse.[10] In contrast, recent studies have shown that the utilization of PoCUS has resulted in more 14% more accurate identification of the carotid pulse at speeds which were not slower than that of a manual pulse check.[8]

Badra K et al[8] conducted a prospective randomized controlled crossover non-inferiority trial comparing pulse detection by manual palpation (MP) versus by point-of-care ultrasound. During this trial, 111 healthcare providers attended a 15-minute focused ultrasound (US) workshop on identification of the carotid pulse. Both pulse check methods were timed for each participant on two different subjects in random order. The primary outcome was time to carotid pulse detection in seconds. Secondary outcomes included confidence levels of pulse detection measured on a 100 mm visual analog scale (VAS) and rates of prolonged pulse checks (> 5 s or >10 s). The primary objective of this study was to determine whether US pulse checks were not slower than MP checks by greater than two seconds. The study found that there were no significant differences between US and MP in the rates of prolonged pulse checks of greater than 5 s (23% vs 19%, $p = 0.45$) or 10 s (9% vs 8%, $p = 0.81$). The trial also found that first attempt at detection of pulse checks was more successful in the US group (99.1% vs 85.6%, $p = 0.0001$). Overall, findings showed that carotid pulse detection in live subjects was not slower using US as compared to palpation and demonstrated higher first attempt success rate and less variability in measurement times.[8]

Although PoCUS allows for potentially more accurate identification of PEA and pseudo-PEA, the prognosis for patients with out-of-hospital cardiac arrest is overall quite poor. Ventricular fibrillation/pulseless ventricular tachycardia has the best prognosis, followed by PEA, with asystole portending the worst prognosis.[2] It is important in these patients to attempt to predict their likelihood of achieving ROSC during cardiac resuscitation. ROSC is defined as the resumption of a normal heart rhythm with a perceptible pulse[11]. ROSC is an important metric as patients who achieve ROSC during cardiac resuscitation have been shown to have better long-term outcomes compared to those who did not achieve ROSC.[12] A study by Chardoli et al. examined the resuscitation outcome for PEA arrest patients, and found that 43% of the patients with pseudo-PEA achieved ROSC, whereas no patients with true PEA achieved ROSC.[13] This study highlights the importance of distinguishing true PEA from pseudo-PEA by showing that patients in pseudo-PEA are far more likely to achieve ROSC as a result of PoCUS intervention.

The study conducted by Wu C et al[3] evaluated the predictive value of bedside ultrasound to restore spontaneous circulation in patients with pulseless electrical activity. This was a systematic review and meta-analysis of studies that used POCUS to predict ROSC. A search of electronic databases (Cochrane Central, MEDLINE, EMBASE) was conducted up to June 2017, and the assessment of study quality was performed with the Newcastle-Ottawa Scale. Eleven studies that enrolled a total of 777 PEA patients were included. A total of 230 patients experienced ROSC. Of these, 188 had sonographically identified cardiac activity (pseudo-PEA). A meta-analysis showed that PEA patients with cardiac activity on US were more likely to obtain ROSC compared to those with cardiac standstill: risk ratio (RR) = 4.35 (95% confidence interval [CI], 2.20-8.63; p<0,00001). It should be noted that POCUS evaluation only utilized the subxiphoid view. Overall, this systematic review and meta-analysis determined that in cardiac

arrest patients who present with PEA, bedside US has an important role in predicting ROSC, and that the presence of cardiac activity in PEA patients may encourage more aggressive resuscitation.[3]

The study conducted by Gaspari R et al[4] which was a non-randomized, prospective, protocol-driven observational study at 20 hospitals across United States and Canada. The purpose of this study to determine whether cardiac activity on ultrasound during ACLS is associated with improved survival and to determine if POCUS would have a potential role in identifying interventions outside of the ACLS algorithm. In this study, patients presenting with out-of-hospital arrest or in-ED arrest with pulseless electrical activity were included. It is important to note that patients presenting with asystole were also included. An ultrasound was performed at the beginning and end of ACLS. The primary outcome was survival to hospital admission. Secondary outcomes included survival to hospital discharge and return of spontaneous circulation. 793 patients were enrolled, 208 (26.2%) survived the initial resuscitation, 114 (14.4%) survived to hospital admission, and 13 (1.6%) survived to hospital discharge[4]. Cardiac activity on US was the variable most associated with survival at all time points. Overall, the study found that Cardiac activity on ultrasound was the variable most associated with survival following cardiac arrest[4], and that utilization of POCUS during cardiac arrest identifies interventions outside of the standard ACLS algorithm.

LIMITATIONS

Some of the studies mentioned in this review represented only a small sample size. A larger sample size of subjects with PEA and pseudo-PEA should be studied before application of the conclusions of these studies can be considered for the general population. In addition, the patients in these studies may have varying underlying causes for their pseudo-PEA, and this may

affect the reliability of the studies. Furthermore, the variability of sonography experience and skill set may limit the practicality of incorporating PoCUS into cardiac resuscitation protocol. Other limiting factors of PoCUS incorporation include lack of resources and understaffed cardiac response teams.

CONCLUSION

PEA and pseudo-PEA are life threatening conditions which require different management pathways. In order to properly and expediently treat these conditions, it is crucial that they are distinguished and diagnosed as soon as possible. The studies highlighted in this review suggest that the utilization of PoCUS in the setting of PEA can be a valuable asset for the properly trained clinician to determine whether cardiac activity is present despite an undetectable pulse. While these studies suggest that the utilization of PoCUS is more accurate in the detection of the carotid pulse when compared to manual palpation, it is likely that more studies are needed in order to show overwhelming evidence of the clear benefit and to convince governing bodies, such as the AHA, that PoCUS has a definitive role to play in the ACLS algorithm.

ARTICLE SUMMARY

1. **Why is this topic important?**

   PEA accounts for approximately 20% of sudden cardiac deaths outside of the hospital setting. Many of these cases may be pseudo-PEA rather than true PEA and should be treated as profound shock with aggressive fluid resuscitation and exploration of underlying etiology rather than with CPR and epinephrine. PoCUS can help distinguish pseudo-PEA from true PEA and be a useful tool in improving patient outcomes.

2. **What does this review attempt to show?**

   This clinical review aims to examine the utility and practical implementation of PoCUS versus manual pulse check in the prediction of ROSC for patients presenting to the hospital in PEA.

3. **What are the key findings?**

   1. A large, multicenter observational study found that cardiac activity on ultrasound was the variable most associated with survival following cardiac arrest.
   2. Manual pulse checks have been shown to be insensitive, not specific and have poor reliability for detecting cardiac activity. One study showed that rescuer pulse palpation was only 78% accurate. Even if a pulse is felt, this does not guarantee adequate perfusion to vital organs.
   3. Some observational studies have shown that use of PoCUS during cardiac arrest prolongs pauses in chest compressions, however a recent study showed that with minimal training POCUS pulse checks can consistently be performed in < 5 seconds and are clearly determinate, even when palpation yields indeterminate results.

REFERENCES

1. Oliver TI, Sadiq U, Grossman SA. Pulseless Electrical Activity. [Updated 2022 Jan 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-.
2. Rabjohns, Jennifer et al. "Pseudo-Pulseless Electrical Activity in the Emergency Department, an Evidence Based Approach." The American journal of emergency medicine. 38.2 (2020): 371–375. Web.
3. Wu C et al. The Predictive Value of Bedside Ultrasound to Restore Spontaneous Circulation in Patients with Pulseless Electrical Activity: A Systematic Review and Meta-Analysis. PLos one 2018.
4. Gaspari R et al. Emergency Department Point-Of-Care Ultrasound in Out-Of-Hospital and in-ED Cardiac Arrest. Resuscitation 2016; 109: 33 – 39.
5. U.A. Flato, E.F. Paiva, M.T. Carballo, et al. Echocardiography for prognostication during the resuscitation of intensive care unit patients with non-shockable rhythm cardiac arrest Resuscitation, 92 (2015), pp. 1-6
6. M. Attin, R.G. Tucker, M.G. Carey In-hospital cardiac arrest: an update on pulseless electrical activity and asystole. Crit Care Nurs Clin North Am, 28 (3) (2016), pp. 387-397
7. M.A. Huis in 't Veld, M.G. Allison, D.S. Bostick, K.R. Fisher, O.G. Goloubeva, M.D. Witting, M.E. Winters Ultrasound use during cardiopulmonary resuscitation is associated with delays in chest compressions. Resuscitation, 119 (2017), pp. 95-98
8. Badra K, Coutin A, Simard R, Pinto R, Lee JS, Chenkin J. The POCUS pulse check: A randomized controlled crossover study comparing pulse detection by palpation versus by point-of-care ultrasound. Resuscitation. 2019;139:17-23.

9. Eberle B, Dick WF, Schneider T, Wisser G, Doetsch S, Tzanova I. Checking the carotid pulse check: diagnostic accuracy of first responders in patients with and without a pulse. Resuscitation. 1996; 33(2):107-116.
10. Ochoa FJ, Ramalle-Gómara E, Carpintero J., Garcıá A, Saralegui I. Competence of health professionals to check the carotid pulse. Resuscitation. 1998; 37(3):173-175.
11. Yagi T, Nagao K, Kawamorita T, Soga T, Ishii M, Chiba N, Watanabe K, Tani S, Yoshino A, Hirayama A, Sakatani K. Detection of ROSC in Patients with Cardiac Arrest During Chest Compression Using NIRS: A Pilot Study. Adv Exp Med Biol. 2016;876:151-157. doi: 10.1007/978-1-4939-3023-4_19. PMID: 26782207.
12. Shin H, Kim G, Lee Y, Moon H, Choi H, Lee CA, Choi HJ, Park Y, Lee K, Jeong W. Can We Predict Good Survival Outcomes by Classifying Initial and Re-Arrest Rhythm Change Patterns in Out-of-Hospital Cardiac Arrest Settings? Cureus. 2020 Dec 10;12(12):e12019. doi: 10.7759/cureus.12019. PMID: 33437558; PMCID: PMC7793532.
13. M. Chardoli, F. Heidari, S. Shuang-ming, et al. Echocardiography integrated ACLS protocol versus conventional cardiopulmonary resuscitation in patients with pulseless electrical activity cardiac arrest. Chin J Traumatol, 15 (5) (2012), pp. 284-287