Critical Review Form
Prognosis

PGY-2

Can Cardiac Sonography and Capnography Be Used Independently and in Combination to Predict Resuscitation Outcomes? *Academic Emergency Medicine*. 2001;8(6):610-615.

Objectives: **"to determine the feasibility of performing cardiac sonography during resuscitation and to evaluate the utility of cardiac sonography and capnography, both separately and together, as predictors of successful resuscitation of pulseless patients." (p. 610-11)**

Methods: **This prospective observational study was conducted on nonconsecutive patients at two community emergency departments associated with emergency medicine residency programs. Focused cardiac ultrasound was performed on arrival to the ED during the pulse check, and with any change in cardiac rhythm (or as dictated by the resuscitation) using the subxiphoid view when possible; apical views were used when body habitus dictated. Capnography was performed on arrival to the ED in patients who were intubated by EMS, and after intubation when this was performed in the ED, and was recorded simultaneous with cardiac ultrasound exams, with only peak $ETCO_2$ levels recorded. The primary outcome was survival to hospital admission.**

Over a 12-month period, 102 subjects were enrolled. Patient underwent a mean of 1.8 cardiac ultrasounds during resuscitation, with a range of 1-5 ultrasound examinations.

Guide		Comments
I.	**Are the results valid?**	
A.	**Was the sample of patients representative?** *In other words, how were subjects selected and did they pass through some sort of "filtering" system which could bias your results based on a non-representative sample. Also, were objective criteria used to diagnose the patients with the disorder?*	Prospective observational study design that followed a *non-consecutive convenience sample* of **pulseless** patients with ongoing cardiac arrest when an ultrasound OR capnography was present. This may bias the sample since individuals with an interest in acute resuscitation were present for select codes but not others. However, survival **to hospital admission** rates were similar compared to historical reports (McNally 2011) although among PEA/asystole cases was higher (~13%) than in other studies (~5%). In general convenience sampling will bias the results compared to taking consecutive cases.
B.	**Were the patients sufficiently homogeneous with respect to prognostic risk?** *In other words, did all patients share a similar risk from during the study period or was one group expected to begin with a higher morbidity or mortality risk?*	There was heterogeneous prognostic risk. This risk of death is lower among patients in ventricular tachycardia and ventricular fibrillation compared to asystole or PEA. Important known prognostic factors such as witnessed arrest, bystander CPR, and early (<8minutes) defibrillation are **not reported (**Sasson 2010). Rates of survival **to hospital** admission can vary for Vfib up to 35%. Rates for **survival to admission** for PEA/Asystole survival are between 1-15%. **Overall survival to hospital discharge hovers around 7% and has not changed in over a decade.**
C.	**Was follow-up sufficiently complete?** *In other words, were the investigators able to follow-up on subjects as planned or were a significant number lost to follow-up?*	It appears that all 102 patients were followed to hospital admission. The heart was identifiable in all 102 patients by ultrasound.
D.	**Were objective and unbiased outcome criteria used?** Investigators should clearly specify and define their target outcomes before the study and whenever possible they should base their criteria on objective measures.	The outcome was survival to the hospital. The investigators did not rigorously define this. How long did patients survive in the ICU after admission? Would allotment groups change if admission survival was only 1 hour? How about the effect of boarding on survival to admission? On the other hand admission to the hospital usually means an ICU took the patient from the ED. Explicit use of Utstein-style reporting would have made this a nice component of the study.
II.	**What are the results?**	
A.	**How likely are the outcomes over time?**	• Overall 13/102 (13%, 95% CI 7-21%) subjects survived to hospital admission. • 2/61 (3.3%, 95% CI 0.9-11%). patients without cardiac activity on US survived to hospital admission.

		• As a diagnostic test the sensitivity of no cardiac activity predicting death was 68% (57-77%) and the LR + was 4.3 (1.2 to 16). • The median ETCO2 for survivors was 39 vs. 13.7 for non survivors (no IQR reported) and this was significant ($p < 0.01$). • Among 22 patients with an ETCO2 less than 16 and NO cardiac activity none survived (0%, 95% CI 0-15%). • Using logistic regression cardiac activity was NOT a significant predictor to hospital admission (OR 1.09, 95% CI .07 to 16.4). ETCO2 was better. For every 1 unit increase in Torr survival increased by 16%. (OR 1.16, 95%CI 1.05 to 1.29). The model was only of adequate fit. The Hosmer-Lemeshaw goodness of fit test was not statistically significant (a good thing). Area under the curve was 0.9, which is encouraging.
B.	**How precise are the estimates of likelihood?** *In other words, what are the confidence intervals for the given outcome likelihoods?*	See above. None of the estimates are sufficiently precise to change practice. Ethically speaking, the 95% CIs for a predictor of "death" should be very tight (0-3%). None of the predictors identified in this study meet these criteria although they are interesting to pursue for further study.
III.	**How can I apply the results to patient care?**	
A.	**Were the study patients and their management similar to those in my practice?**	Yes. The study patients were likely similar to those in our practice although we know little of ACLS training requirements or quality of CPR/ACLS (a concept that has evolved since the publication of this study)
B.	**Was the follow-up sufficiently long?**	No. For the stated outcome (admission to the hospital) the follow up was appropriate. However we now use Utstein criteria and would not consider hospital admission as important as discharge from the hospital. Interestingly, this result would validate these data further since one could presume that long-term survival would decrease and the current survival rates are quite low. However, it is difficult to know since the authors stopped at hospital admission only.
C.	**Can I use the results in the management of patients in my practice?**	No. Only insofar as to inform judgment. We cannot wholly rely on these data to change our practice and perform ultrasound to predict prognosis. However, it is likely we can use US in conjunction with other on scene variables (EMS CPR, witnessed bystander, ROSC on

		scene, etc.) to further manage our judgments when there is no cardiac activity noted. However larger studies are needed before practice is changed.

Limitations:

1) **Failure to follow STROBE statement guidelines for reporting in observational trials.**
    a. **Dates of study enrollment not detailed**
    b. **Eligibility criteria not well-defined**
    c. **Non-consecutive sample used with no explanation as to why**
    d. **No demographic data reported**
    e. **No resuscitation data (time to EMS arrival, time to ED arrival, total downtime at ED arrival)**

2) **The outcome for the pooled estimates was ROSC, rather than more patient-important outcomes, such as survival to hospital discharge and neurologically-intact survival.**

Bottom Line:

In this study, 2 out of 59 patients with cardiac standstill on ultrasound survived to hospital admission. While more important outcomes such as survival to hospital discharge and neurologically intact survival were not addressed, these results suggest that absence of cardiac activity alone can not be used to predict the outcome of cardiac arrest. Failure to adhere to STROBE statement guidelines makes further interpretation and external application of the results difficult.