Out of Hospital Cardiac Arrest: What Do the Numbers Tell Us?

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Introduction

The benefits of sodium bicarbonate use in treating out of hospital cardiac arrest (OHCA) have been debated and have fluctuated over time. Both prospective and retrospective studies have been done. With an aggregate of these studies there is little evidence that sodium bicarbonate is effective in preventing morbidity and mortality in patients experiencing OHCA.[1] Overall OHCA treated by Emergency Medical Services (EMS) has an incidence of 73 per 100,000 and an average survival to hospital discharge of 11.4% for adults.[2]

With the information available and more recent guidelines and evidence showing less support for the use in utilizing sodium bicarbonate in a prehospital cardiac arrest,[3] it should be assessed if this evidence extends to the population seen at MU hospital to guide further appropriate care and policies.

Additionally, trends in 30-day survival should be evaluated for significance and appropriate change in practice should be considered both for continued aggressive care and limiting nonbeneficial intervention during OHCA.

Questions

- Does the use of sodium bicarbonate during all OHCA lead to a decrease in 30-day survival when compared to a similar group of OHCA that received calcium?
  - What trends can be established that enhance 30-day survival in OHCA?
  - What trends can be established that support limiting or withdrawing care during OHCA to prevent futile treatment?

Methods

A retrospective cohort study design was used to assess the use of sodium bicarbonate in all cause OHCA. Data was gathered from Missouri Ambulance Reporting System (MARS) and included OHCA with sodium bicarbonate use from January 2008-December 2017 (n=17), and OHCA with calcium use from January 2016-December 2017 (n=17) as a comparison group. The patients were then found in the University of Missouri Hospital electronic medical record (EMR) and followed until 30-days post arrest or until death, whichever came first. Multiple data points were obtained both in MARS and the hospital EMR to ensure group similarity. Primary end point of 30-day survival was assessed as well as other factors that influence 30-day survival.

Additionally, all OHCA from January 2016-May 2018 were obtained from MARS and the hospital EMR in a similar fashion and added to the group to assess for broader trends in OHCA. In total 105 patients were identified; 12 patients were removed for incomplete documentation for a total patient population of 93.

From the total population, variables that were evaluated included: witnessed arrest, bystander CPR, bystander AED use, initial shockable rhythm, scene time and initial pH upon ED arrival (figure 1).

Results

Sodium bicarbonate use:

Comparison of patients who received sodium bicarbonate and patients who received calcium during an OHCA showed no significant difference in 30-day survival with a 11.7% (n=2) survival in the calcium group and a 0% survival in the sodium bicarbonate group (p=0.153).

Witnessed arrest:

With a witnessed arrest compared to a unwitnessed arrest there was a significant increase in: shockable rhythm (31%:2%, p<0.01), defibrillation (43%: 17%, p=0.006), amiodarone use (18%:4%, p=.032), and 30-day survival (14.5%:0%, p=0.007).

Bystander CPR and AED use:

Bystander CPR significantly increased 30-day survival (17.65%: 1.69%, p=0.004) compared to no bystander CPR. Additionally bystander AED use independently increased 30-day survival (100%:5.5%, p<0.01) as well.

Shockable rhythm:

A initial shockable rhythm had many significant differences compared to a initial rhythm that was not shockable and included: higher likelihood that it was a witnessed arrest (92%:42%, p<0.01), increase in magnesium and amiodarone use, increased initial pH (7.19:6.99, p<0.01) and increased 30-day survival (31%:2.6%, p<0.01).

Only one patient survived to 30-days after an initial non shockable rhythm, and no patients survived to 30-days who's initial rhythm was asystole.

Scene time:

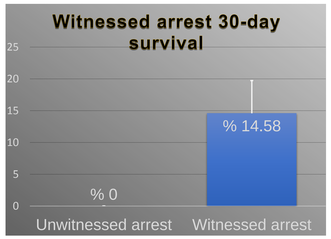
Scene time was divided into less than and more than 20 minutes on scene. With that, there was a significant increase in 30-day survival for the group that had less than 20 minute scene time (11.9%:0%, p=0.03).

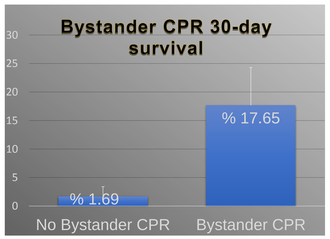
Additionally, the group that had more than 20 minutes on scene had higher use of sodium bicarbonate, calcium and second dose of epinephrine, likely due to prolonged resuscitation and lack of ROSC.

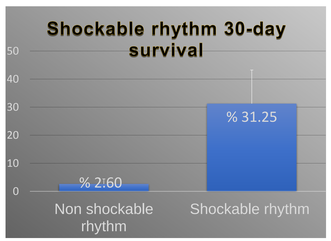
Initial pH:

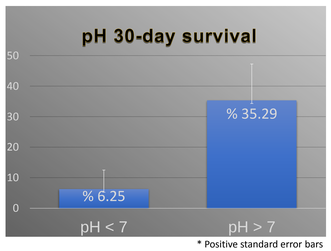
Initial pH was assessed and divided into more and less than 7.00. A higher pH lead to higher likelihood of a witnessed arrest, bystander CPR, increased defibrillation and increased 30-day survival (35%:6.2%, p=0.04) and less use of second dose of epinephrine.

Only one patient with a pH less then 7.00 survived to 30-days. The patients initial pH was 6.998.









* Positive standard error bars

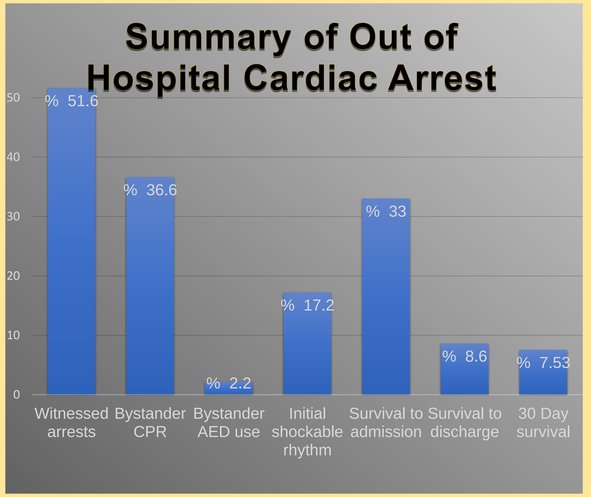


Figure 1: Overall summary of data obtained from all OHCA evaluated (n=93). Data were independently assessed for rate of survival.

Conclusion

This study suggests the use of sodium bicarbonate does not improve or worsen outcomes compared to a similar group, however there were no survivors at 30-days when bicarbonate was used in OHCA. With this knowledge once bicarbonate is being considered in OHCA, providers should also evaluate the likelihood of a successful resuscitation by weighing all known facts that correlate with 30-day survival, to determine if they should consider not starting, continuing or stopping resuscitation such as:

Continue resuscitation if:	Stop resuscitation if:
• Witnessed arrest	• Unwitnessed arrest
• Bystander CPR	• Prolonged down time
• Bystander AED use	• Initial non shockable rhythm
• Initial shockable rhythm	• Scene time >20 minutes
• Scene time < 20 minutes	• Initial pH less than 7.00
• Initial pH greater than 7.00	

References:

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3. Part 8: Adult Advanced Cardiovascular Life Support. Robert W. Neumar et. al, Circulation. 2010;122:S729-S767, originally published October 17, 2010