UAMS EM Journal Club
September 2021 Summary
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IV versus an IO in Cardiac Arrest

Clinical Bottom Line:
This study found that after propensity matching, the IO group had no difference in 30-day survival and neurological outcome, but they did have decreased likelihood of short-term survival (ROSC and 0 day). There does not appear to be a clear benefit in the preferential use of IO based on this study.

PICO Question:
In cardiac arrest patients, does placement of an IO as compared to placement of an IV improve clinical outcomes as measured by increased rates of ROSC, survival to hospital discharge, or survival with intact neurological status?

Background:
According to the AHA, in 2015, approximately 350, 000 people suffered out of hospital cardiac arrest (OHCA)[1, 2]. Only about 10% survive their OHCA and even fewer, only 8.5%, survive with good neurologic function[1]. In-hospital cardiac arrests occur in 1.2% of admitted adult patients[1]. Of these in-hospital cardiac arrests, only 25.8% survive to discharge with 82% of these survivors being neurologically intact[1]. Given the poor prognosis of cardiac arrest, there is a lot of research on the subject to improve clinical outcomes.

In addition to the many tasks that need to occur simultaneously during a cardiac arrest, it can often be difficult to obtain intravenous (IV) access in a patient with cardiovascular collapse. The AHA guidelines have listed intraosseous (IO) access as an acceptable alternative to IV access in their ACLS protocol[1]. However, it is not well known how IV access versus IO access affects patient outcomes during cardiac arrest[3].

The following paper discussed the question: In cardiac arrest patients, does placement of an IO as compared to placement of an IV improve clinical outcomes as measured by increased rates of ROSC, survival to hospital discharge, or survival with intact neurological status? In "Intraosseous Versus Peripheral Intravenous Access During Out-Of-Hospital Cardiac Arrest: A Comparison Of 30-Day Survival and Neurological Outcome in The French National Registry," researchers evaluated out of hospital cardiac arrests (OHCA)[4]. The results of this article will be discussed in this paper.

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Trial: Valentine, B., Christian, V., Escutnaire Joséphine, Nave, S., Delphine, H., Tahar, C., . . . Hubert, H. (2020). Intraosseous versus peripheral intravenous access during out-of-hospital cardiac arrest: A comparison of 30-day survival and neurological outcome in the French national

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registry. Cardiovascular Drugs and Therapy, 34(2), 189-197.
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Pubmed link:

Validity:
For the most part, the results of this study are valid. The strengths of the validity include the study population was representative of the population, they used validated tools to assess the outcomes and statistical data, they used propensity score matching to account for confounders, and there was complete follow up of the patients. A few aspects of validity that could be improved include there may be some unaccounted-for confounders, the assessors and subjects were not blinded, and the definitions of who was in the IV and the IO groups were not well defined.

The cohort was representative of the population. It looked at a large number of patients from a database that was a composite of records from multiple EMS agencies that had geographic diversity. The average age of the patient was 67 years old and predominantly (69.9%) male Also, most patients had a history of cardiac disease or diabetes. These characteristics are found in most cardiac arrest patients.

They used validated tools and statistical methods to analyze the outcomes and the statistical data. One of the endpoints of this study was neurological function, which was assessed with the validated scoring system, the Cerebral Performance Category (CPC) score. There was some missing data from the registry; however, the researchers used a validated statistical tool, multiple imputation method, to account for this.

The researchers also accounted for confounders by using propensity score matching. This is necessary due to this being an observational study rather than a randomized controlled clinical trial. Although confounders were accounted for with this method, I think there could still be unaccounted for confounders. For example, patients may have certain characteristics that bias the providers to perform IV versus IO. Also, there may be certain protocols in place in the France EMS system that influence whether a patient gets an IV versus an IO.

The follow up was complete for this study. They looked at ROSC, 0-day survival and 30-day survival with neurologic outcome. I think that by this timeframe, the patients would have declared what their survival and neurologic outcome would be.

One potential limitation to the validity is that the researchers were not blinded to the exposure (IV versus IO). This should not affect their assessment of survival at the time intervals since this is an objective data point. However, this could affect the CPC score assigned to the patients given this score has subjectivity of what a patient's functional status is at a certain time point.

Another issue with the validity of this study is that it was not defined how patients were assigned to the IV or IO groups. It is not known if the patient received an IV that then infiltrated and then received and IO and was counted as part of the IV or IO group. In other words, it is not known if the patients received an IV or IO or both.

The Basics:
The researchers performed a retrospective cohort study utilizing the French National Cardiac Arrest Registry (RéAC) to evaluate if the use of IV versus IO had an effect on patient outcomes as measured by increased rates of ROSC, survival to hospital admission, survival to hospital discharge or at 30 days, and survival to hospital discharge or at 30 days with intact neurological status. Given the observational nature of this study, the researchers used propensity score matching to account for potential confounders. They calculated odds ratios, with their associated confidence intervals, to describe the rates of ROSC, 0-day survival, 30-day survival, and neurologic function at 30 days or hospital discharge. These odds ratios were calculated for the data set as a whole (before matching) and with a set of 1568 pairs after propensity matching was performed.

Inclusion Criteria:
This retrospective cohort study included all MMT (i.e. ACLS capable EMS crew) treated patient with out of hospital cardiac arrest (OHCA). The data for this study was collected from the French National Cardiac Arrest Registry (RéAC). The participating EMS agencies in France that use this registry use a universal form to fill out various data points about patient care. The EMS system in France utilizes a two-tier system with the first tier being a basic life support (BLS) unit and the second being a mobile medical team (MMT) that has advance life support (ALS) skills.

Exclusion Criteria:
The exclusion criteria for the study were: patients with obvious death (example: rigor mortis), patient less than 18 years old, prolonged cardiac arrest, patients with do not attempt resuscitation (DNAR) directives, patients who did not receive ALS care, patients with unknown rhythm on ALS arrival, patients with ROSC before ALS arrived, patients without epinephrine injection, patients who did not have vascular access, patients with access other than IV or IO, and patients that did not have medical arrest (example: drowning, OD, hanging/asphyxia, trauma, electrocution).

Primary Outcome:
The primary outcome was patient survival at 30 days or at hospital discharge.

Other Endpoints:

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The secondary endpoints were return of spontaneous circulation (ROSC), the 0-day survival (at hospital admission) and the 30-day or at hospital discharge neurological outcome. Neurological outcome was determined using the cerebral performance category (CPC) scores.

Results:
Due to this being an observational study, the researchers used propensity score matching to account for confounders and mimic randomization.

Before matching, the researchers found that the IO group had a decreased chance of survival at all stages (ROSC, 0-day, and 30 day). The IO group had no difference in neurological outcome.

After propensity matching was performed, the researchers found that IO group had no difference in 30-day survival and neurological outcome. The IO group did have decreased likelihood of short-term survival (ROSC and 0 day).

In other words, the IO group had decreased chance of ROSC and 0-day survival before and after matching. The IO group had decreased chance of 30-day survival before matching but no difference after matching. Lastly, the IO group had no difference in neurological outcome at 30 days or at hospital discharge before or after matching.

Limitations/Bias:
There were several limitations to this study.

This study utilized the French National Cardiac Arrest Registry (RéAC); therefore, for patient data to be included in this study, the EMS agency who cared for the patient had to be part of this registry. Not all EMS agencies in France were part of this registry during the study dates. The article suggests that this limitation is mitigated because there were a lot of EMS agencies who participated, and they had geographical diversity. Therefore, this registry's data likely shows a fair representation of the population in France.

Another limitation of this study was that it was performed in France. There could be different EMS protocols and medical practices in France as compared to other countries, such as the United States. This could be limitation for applying the findings of this study to other populations.

A third limitation would be that the database had missing baseline data in 16.9% of the study samples. The researchers accounted for this by using the statistical method, multiple imputation method.

A fourth limitation is that this was an observational study rather than a randomized control trial. One issue with observational studies is confounders could be altering your results. For

example, there could be a characteristic that is shared among the patients in the IO group that is affecting the outcome (survival, neurological function). To account for confounders, the researchers used propensity score matching. They matched patients based on 5 characteristics: patient's age, etiology of OHCA, time between call (T0) and epinephrine injection, shock before MMT (i.e., ACLS) arrival, and patients' initial rhythm. They utilized these factors because these confounders that are known to influence survival from cardiac arrest.

Lastly, it is unclear how the IV and IO groups were defined. It is unknown if the patients received an IV, IO, or both if one access type failed during the resuscitation. Also, this study does not specify the anatomical location of the IV and IO access. For example, it does not clarify if the IO was in the tibia or humerus, which could affect outcomes.

References

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