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Editorial

To intubate or not to intubate for pediatric out of hospital cardiac arrest? That is the question

How to best manage the airway in pediatric out of hospital cardiac arrest (OHCA) remains controversial. As the most common etiology of pediatric OHCA is respiratory[1] advanced airway management (AAM) with an endotracheal tube (ETI) or supraglottic airway (SGA) may be beneficial. However, pediatric OHCA is a rare event, making pediatric airway skill retention problematic for emergency medical system (EMS) providers. Advanced airway placement may also affect the quality of cardiopulmonary resuscitation (CPR) with interruptions in chest compressions,[2] hyperventilation,[3] and prolongation of the time on the scene.[4] In a landmark randomized clinical trial from the 1990s, Dr. Gausche-Hill and colleagues,[5] compared bag mask ventilation (BMV) with BMV followed by ETI in pediatric respiratory emergencies, and showed no difference in survival and neurologic outcome between the two strategies.[5] Recent observational studies have attempted to determine the association of AAM with outcome in pediatric OHCA with conflicting results.[4,6–8] Information bias in registry data used for these studies may have led to these discrepancies. Airway "success" is the successful placement of an ETI or SGA, whereas "failed" attempts at AAM are misclassified and analyzed as no AAM or as BMV. Other missing data include the sequence of AAM e.g. SGA following failed ETI and the number of attempts at during AAM. The timing of advanced airway placement is often not available and is subject to recall bias. Additionally, arrests may only receive BMV if early return of spontaneous circulation (ROSC) occurs, whereas those with longer resuscitation times are likely to have more intra-arrest interventions including AAM, and poor outcome related to longer resuscitation time,[4] thus introducing additional bias known as "resuscitation time bias". Given that EMS protocols continue to recommend AAM,[9] and that outcomes following pediatric OHCA remain poor,[10–12] it is imperative to determine whether AAM is associated with poor outcome in this vulnerable population.

In this issue of Resuscitation Dr. Okubo et al.[13] have attempted to answer the question of whether AAM impacts outcome in OHCA while addressing resuscitation time bias. The All-Japan Utstein registry was utilized to study pediatric traumatic and non-traumatic OHCAs between 2014 and 2016 to examine the association of AAM with 1-month survival and 1-month neurologically favorable outcome. The investigators used time-dependent propensity scores to match each OHCA receiving an advanced airway at any given minute after initiation of CPR to an OHCA receiving BMV with a similar risk of receiving an advanced airway (risk set matching). Propensity scores included demographics, arrest characteristics, regional variation preferences for performing AAM, bystander interventions and EMS interventions. Prehospital ROSC was analyzed as a competing risk in the regression model. In unadjusted analyses there were significant differences in baseline characteristics between no AAM and AAM which included differences in age, sex, regional variation preferences for performing AAM, arrest etiology, bystander interventions and EMS interventions including epinephrine administration and EMS shock delivery. Propensity adjustment created good balance between the two group's baseline characteristics. The results show a small proportion pediatric OHCA (12.7%) had AAM, the majority were SGA's (86.9%). In the matched cohort there were no differences in survival with 11.4% with AAM and 9.6% with no AAM, risk difference 1.5% (95% CI −3.0, 6.1), and neurological outcome with 2% with AAM and 2.2% with no AAM, risk difference −0.8% (95% CI −2.9, 1.3). The robustness of these results was confirmed with sensitivity analyses of airway type and timing of matching that continued to show no difference in outcomes.

These data are similar to an All-Japan Utstein registry report that analyzed data from 2011 to 2012 and found no difference in neurologically favorable survival between AAM and BMV in an unmatched and propensity matched cohort of pediatric OHCA (excluding infants).[6] In contrast, in a North American study from 2005 to 2012 that included pediatric OHCA from sites in the United States (US) and Canada from the Resuscitation Outcomes Consortium (ROC), AAM was not associated with survival.[4] With congruent results to the ROC study, a report from the US Cardiac Arrest Registry to Enhance Survival from 2013 to 2015, reported a lower odds of survival with both ETI and SGA compared to BMV in propensity matched cohorts.[7] To add to the controversy, a study from the Pan-Asian Resuscitation Outcomes registry from 2009 to 2012 reported AAM was only associated with survival in children less than 13 years of age.[8] Part of the discrepancy in these results may also be attributed to the predominant type of airway placed with more SGA use in Japanese and Pan-Asian studies and more ETI in the US and Canada. A recent systematic review and meta-analysis on airway management for pediatric cardiac arrest concluded that survival and neurologically favorable outcome were associated with BMV over ETI and SGA, with limited data favoring SGA over ETI. The majority of studies in this meta-analysis were on OHCA.[14]

The novelty and strength of the report by Dr. Okubo et al.[13] is the thorough statistical analysis that includes the use of time-dependent propensity scores and risk-set matching to address unmeasured confounding and resuscitation time bias. The main limitation of this

study remains that "failed" AAM is not available in the All-Japan Utstein registry therefore OHCAs with an attempted advanced airway that failed were possibly misclassified in the no AAM group as compared to being analyzed in the "intention to treat" AAM group thus making outcome in the two groups more similar. The results of this study may also not be generalizable to other countries given the predominant use of SGAs for AAM. The most common advanced airway strategy in the US for pediatric OHCA is ETI,[9] whereas in Japan standard EMS providers are trained to place SGAs, and there are fewer specially trained EMS providers who can place ETIs. It is possible that SGAs are easier to place, and associated with less interruption of high-quality CPR compared to ETI. However, these two airway strategies have to date never been compared in a randomized clinical trial in pediatric OHCA, and currently the American Heart Association (AHA) and International Liaison Committee (ILCOR) recommend placement of SGA only if BMV is unsuccessful and ETI is not possible.[15,16]

Despite these limitations this is an important study in pediatric OHCA. Given that there was no difference in outcomes between no AAM and AAM both early and later in arrest, the results of this study support AHA/ILCOR recommendations for BMV in the pre-hospital setting, especially when transport time is short.[15,16] However questions remain, should we place an advanced airway for pediatric OHCA? And if we do should we perform ETI or use SGAs? A recent randomized clinical trial from the ROC found improved outcomes with SGA compared to ETI in adult OHCA.[17] Conducting clinical trials on prehospital airway interventions in pediatric OHCA would challenging given the rarity, heterogeneity, numbers needed to treat, and equipoise in the pediatric resuscitation community. Ethical issues including waiving informed consent for a prehospital intervention in a vulnerable population deserve careful consideration. The authors are to be commended for this contribution to the literature which adds to our uncertainty and pushes us to seriously consider a randomized clinical trial to answer what is the optimal management of the airway, and should we, or should we not intubate for pediatric OHCA?

Conflict of interest statement

Drs. Naim and Zinna have no conflict of interest.

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