Editorial

The end of the road for early tracheal intubation in cardiac arrest?

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Best practices in airway management strategies for both out-of-hospital cardiac arrest (OHCA) and in-hospital cardiac arrest (IHCA) remain a topic of torrid contest. While observational OHCA studies have suggested no advantage in favorable outcomes of survival or neurological-intact survival with the use of tracheal intubation (TI) or other advanced airway techniques compared to bag-valve-mask (BVM) (1-3), IHCA data are more limited. In the absence of clear evidence from randomized controlled trials, current guidelines state that either BVM or an advanced airway may be used for oxygenation and ventilation during cardiopulmonary resuscitation (CPR) in both in-hospital and out-of-hospital settings (4). There remains a need for clear guidance on the best airway approach in cardiac arrest.

In a robust observational cohort study published in the January 2017 issue of the *Journal of American Medical Association*, Andersen *et al*. (5) utilized the Get with The Guidelines-Resuscitation registry (GWTG-R) data, a large prospective quality improvement registry of IHCA in hospitals in the United States, to determine if TI during adult IHCA was associated with increased survival to hospital discharge. The study included adults 18 years and above with an index cardiac arrest for which cardiac compressions were instituted, and excluded patients with invasive airway devices in place. The primary outcome was survival to hospital discharge. The authors also studied the rate of return of spontaneous circulation (ROSC) and favorable functional outcome (using the cerebral performance category score) at hospital discharge.

Of a full cohort of 108,079 patients, 71,615 patients (66.3%) were intubated within the first 15 minutes. Among all intubated patients, the median time to intubation was 5 minutes [interquartile range (IQR) 3-8 mins] (Figure 2 in Andersen *et al.*) (5). This was similar between patients with shockable and non-shockable rhythms. The authors demonstrated that patients who were intubated at any given minute in the first 15 minutes had a lower rate of survival to hospital discharge as compared to those who were not intubated during that minute, both in the unadjusted analysis [relative risk (RR) =0.58; 95% confidence interval (CI): 0.57–0.59] and in the time-dependent propensity score-matched analysis (RR =0.84; 95% CI: 0.81–0.87). Interpreted as such, the risk of survival to hospital discharge was 16% (95% CI: 13–19%) lower in a patient intubated at that given minute (between 0–15 minutes) compared to a similar patient who was not intubated (or not yet intubated) at that minute. A lower likelihood of survival was more strongly associated with intubation in the presence of an initial shockable rhythm (RR =0.68; 95% CI: 0.65–0.72), as compared to a non-shockable one (RR =0.91; 95% CI: 0.88–0.94). Furthermore, there was also a lower likelihood of survival in patients without respiratory insufficiency (RR =0.78; 95% CI: 0.75–0.81) compared to those with preexisting respiratory insufficiency (RR =0.97; 95% CI: 0.92–1.02). With respect to the secondary outcomes, patients intubated at 0-15 minutes were likewise less likely to have ROSC (RR =0.97; 95% CI: 0.96–0.99) and a favorable functional outcome (RR =0.78; 95% CI: 0.75–0.81), compared to those who were not intubated.

The authors chose to use a time-dependent propensity score for matching. In propensity-based matching, a score is computed for each patient, which represents the likelihood of receiving an intervention (e.g., intubation in the first 15 minutes). Patients with similar scores are then matched as pairs. This technique is known to achieve good balance in the presence of multiple prognostic factors especially when the outcome events are few, but similar to traditional regression adjustment, can only account for known confounders that are entered into the propensity model (6). In this study, the time-dependent propensity score was calculated using a multivariable Cox proportional hazards model with time to intubation as the outcome (eAppendix in Andersen *et al.*) (5). This approach would take into account right censoring, should the resuscitation end (either termination or ROSC) without intubation. As opposed to traditional propensity score matching, the use of time-varying covariates (including the first epinephrine dose and the first defibrillation) allowed for covariates to be balanced not only at baseline but also at any given time when patients were at risk for intubation. Patients were matched on the propensity score in a 1:1 risk set, using an algorithm with a maximum caliber of 0.01. Patients who were intubated at any given minute from 0–15 minutes were matched to those at risk of intubation (who had not been intubated at that time). The success of matching was assessed using standardized differences, and patients in each group were similar across all covariates. The authors also performed a sensitivity analysis including patients with missing data after multiple imputations. Although this assumes that the data were missing at random, the results were consistent with the primary analysis, where TI was associated with a lower likelihood of survival (RR =0.84; 95% CI: 0.81–0.87).

The results demonstrated in this study are in keeping with anecdotal evidence and previous reported observational work. TI has been reportedly associated with: interrupted chest compressions (7,8), iatrogenic hypoxia and bradycardia (9,10), and misplacement of TI (11). The finding of a stronger association between TI and decreased survival among patients with a shockable rhythm (compared to a non-shockable rhythm) does suggest that the delay to other definitive measures (e.g., defibrillation) would lead to a poorer outcome.

The authors recognize the limitations to this study. Despite being a large cohort with multiple adjustments, such a design cannot overcome confounding by indication (12). Patients who have more severe physiological compromise would likely have been deemed to require early intubation and these patients would have had a poorer prognosis. The investigators also recognize that information not present in the registry such as the underlying cause of the cardiac arrest, quality of chest compressions and indication for airway control were not available for adjustment. Differential proficiency of resuscitation providers and adherence to current standards may exist between centers, although the investigators did mitigate this by adjusting for hospital characteristics and location of resuscitation.

This well performed study provides the equipoise and a launching platform for an adequately powered multi-center randomized controlled trial. Ongoing trials comparing TI to BVM and other airway devices in the OHCA setting (clinicaltrials.gov identifier NCT02327026, NCT02419573, NCT02967952) could inform but would not replace the need for a clinical trial specific to the IHCA setting (13). We continue to await compelling evidence that could translate into a change in clinical practice.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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