Pragmatic Airway Management in Out-of-Hospital Cardiac Arrest

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Out-of-hospital cardiac arrest is associated with high mortality, with only approximately 11% of patients surviving to hospital discharge.1 There is a need for robust evidence to guide interventions. One of these interventions is airway management, for which contemporary strategies include bag-valve-mask ventilation, endotracheal intubation, or various types of supraglottic airway devices.2 Supraglottic airway devices are inserted blindly and placed in the hypopharynx such that airflow is provided above the glottis. The precise design and placement depend on the type of supraglottic airway. Although each of these 3 airway strategies have theoretical advantages and disadvantages, there is little evidence to recommend one approach over the other.2,3

Endotracheal intubation has traditionally been regarded as the preferred technique for airway management during cardiac arrest, but has been associated with a number of potential detrimental effects such as prolonged interruptions in chest compressions and unrecognized esophageal intubation.4,5 Within the last decade, a number of observational studies have investigated the relationship between airway management techniques and outcomes in out-of-hospital cardiac arrest.6 However, interpretation of these studies is difficult not only due to confounding, but also due to a lack of consideration of the timing of the intervention, such that patients with more prolonged cardiac arrests have a higher chance of receiving advanced airway management.7 Randomized trials have therefore been long awaited.

In this issue of JAMA, 2 such trials are reported. Wang et al8 report the results of a pragmatic cluster-crossover randomized trial (N = 3004) conducted in the United States comparing a strategy of laryngeal tube (a type of supraglottic airway) insertion with a strategy of endotracheal intubation. The investigators found that the laryngeal tube strategy was associated with a clinical and statistically significant increase in 72-hour survival (18.3% vs 15.4%; absolute difference, 2.9% [95% CI, 0.2%-5.6%]). Secondary outcomes, such as survival to hospital discharge (10.8% vs 8.1%) and a favorable neurological status (defined as a modified Rankin Scale score ≤3) at hospital discharge (7.1% vs 5.0%), also favored the laryngeal tube strategy.

In the other trial, Benger et al9 report the results of a pragmatic cluster randomized trial (N = 9296) conducted in the United Kingdom comparing an airway management strategy using a different type of supraglottic airway with a strategy of endotracheal intubation. In contrast to the findings of Wang et al,8 Benger et al9 found no significant difference in the primary outcome of a favorable neurological outcome at 30 days (defined as a modified Rankin Scale score ≤3), which occurred in 6.4% of patients in the supraglottic airway group and 6.8% in the endotracheal intubation group (absolute risk difference, −0.6% [95% CI, −1.6% to 0.4%]).

Both trials have many important strengths including the large sample sizes, inclusion of multiple emergency medical services (EMS) units, and the comparison of commonly used airway management strategies. These strengths are particularly important given the complexity of conducting research in acute conditions in the out-of-hospital setting. However, to understand why these results differ and how they might influence guidelines and clinical practice, a more detailed consideration of the trials and the settings is necessary.

For most EMS personnel, out-of-hospital cardiac arrest is encountered relatively infrequently, limiting their exposure to patients with cardiac arrest and related interventions such as advanced airway management.10 Endotracheal intubation is a skill that needs practice to acquire and maintain.11 In the trial by Wang et al,8 the initial endotracheal intubation success rate was low at 51% (compared with a 91% success rate for paramedics reported in a previous meta-analysis12 and 69% reported in the trial by Benger et al9). Additionally, in the trial by Wang et al,8 33% of patients in the endotracheal intubation group were intubated or reintubated after arrival in the emergency department. Rates of endotracheal intubation or reintubation at hospital admission were not reported in the trial by Benger et al.9 Whether a higher intubation success rate would have altered the results in either trial remains speculative, but previous studies have found that failed airway attempts are associated with worse outcomes.13 As such, it seems pertinent to limit generalizability of the trial findings to similar settings, ie, in settings in which endotracheal intubation success rates are low, simpler and easier techniques, such as a supraglottic airway, might be preferable.

This raises the question of whether an even simpler technique, bag-valve-mask ventilation, would have similar or better outcomes compared with a supraglottic airway. In a recent trial, Jabre et al14 failed to establish noninferiority of bag-valve-mask ventilation compared with endotracheal intubation although the proportions of patients with a favorable neurological outcome (defined as cerebral performance category 1 or 2) at 28 days were remarkably similar (4.3% vs 4.2%). Comparison of this trial with the current trials reported by Wang et al8 and Benger et al9 is difficult because the airway was managed by experienced physicians with a

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reported total intubation failure rate of only 2%,14,15 although intubation success was defined differently in the 3 studies.

The trials by Wang et al8 and Benger et al9 both used a pragmatic cluster randomized design. A pragmatic design is often used to optimize external validity, ie, to help ensure that the findings are applicable outside the specific setting of the trial.16,17 Other reasons, such as budgetary constraints (as noted in the trial by Wang et al8) might also influence the choice of a more pragmatic design. Many elements of the 2 trials were pragmatic including the broad inclusion and exclusion criteria, the lack of informed consent, the use of a strategy of initial airway management (as opposed to an inflexible, protocolized approach), and no requirements regarding care outside of the studied interventions. Other elements of the trials (eg, the primary outcome of 72-hour survival in the trial by Wang et al8 and the use of additional paramedic training in the trial by Benger et al9) were less pragmatic in nature.

Pragmatic trials often use a cluster randomized design.17 The trial by Wang et al8 included a total of 13 clusters (based on EMS agencies), which were randomized to 1 of 2 strategies at certain intervals, whereas the trial by Benger et al9 included a total of 1523 clusters (based on individual paramedics). Based on the trial protocols, it appears that the authors of both trials primarily designed the studies as cluster randomized trials for logistical reasons, but a cluster randomized design also may be appropriate when an intervention is delivered at a group level or when a high risk of spillover effects is possible.18

Even though a cluster randomized design can have logistical advantages, there are drawbacks. Power is decreased and a larger sample size is needed compared with an individual randomized trial. The required increase in the sample size is directly related to the likeness of patients within a cluster (the intrACLuster correlation coefficient) and inversely related to the number of clusters, ie, the more similar patients are within a cluster and the lower the number of clusters, the larger the sample size needed.19 However, some power is potentially regained by allowing the clusters to crossover as occurred in the trial by Wang et al.3,20 Another more concerning potential limitation occurs when the total number of clusters is low. While a sufficiently large randomized trial (individual or cluster) will minimize any baseline imbalances between groups, “sufficiently large” is often not reached in cluster randomized trials such as the investigation by Wang et al8 with only 13 clusters.21 This risks imbalances between groups that could influence results. There is some indication that baseline imbalances (eg, time to arrival of the EMS personnel) favoring the laryngeal tube group were present in the trial by Wang et al8 as suggested by the attenuated and nonsignificant results in the adjusted analyses. The large number of clusters in the trial by Benger et al9 largely eliminated the risk of chance imbalances between groups.

Although the primary results in the trial by Benger et al9 did not show superiority of the supraglottic airway strategy, the authors conducted a number of additional analyses, some of which suggest that the supraglottic airway strategy was superior. In one of these analyses, the authors compared the 2 strategies when restricting the cohort to patients who received advanced airway management (ie, excluding those only requiring bag-valve-mask ventilation). Although this might seem like a reasonable analysis, this is essentially a nonrandomized comparison because the number of patients excluded differed substantially between the 2 groups. Such analysis can therefore be biased and should be interpreted with caution. Importantly, in the trial by Benger et al9 only 62% of patients randomized to the intubation strategy actually had intubation attempted, whereas 82% randomized to the supraglottic airway strategy had this procedure attempted. In the trial by Wang et al8, the corresponding proportions of patients having the assigned airway strategy attempted were 77% in the intubation group and 85% in the supraglottic airway group, illustrating that EMS personnel favored the supraglottic airway in both trials. The number of patients who actually received the airway to which they were randomized was even lower.

Despite limitations, the trials by Wang et al8 and Benger et al9 provide important new evidence regarding airway management in out-of-hospital cardiac arrest and again raise the important question of whether endotracheal intubation should be the preferred choice of airway management. EMS personnel and physicians involved with protocol development for EMS systems in the United States, United Kingdom, and similar settings with limited exposure to advanced airway management should reconsider the routine use of endotracheal intubation as the first-line strategy for airway management in out-of-hospital cardiac arrest.

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REFERENCES


