Comparative Effectiveness Review
Number 243

Prehospital Airway Management: A Systematic Review

Evidence Summary

Main Points

- Four Key Questions addressed the comparative benefits and harms across three airway management approaches by emergency medical services in the prehospital setting: Key Question 1 – bag valve mask [BVM] versus supraglottic airway [SGA]; Key Question 2 – BVM versus endotracheal intubation [ETI]); Key Question 3 – SGA versus ETI; and Key Question 4 – how the benefits and harms differ based on patient characteristics, techniques, and devices.
- The most common finding, across emergency types and age groups, was of no differences in primary outcomes when prehospital airway management approaches were directly compared.
- None of the conclusions were supported by high strength of evidence (SOE); thus, future, more rigorous studies could change the findings.
- The following conclusions for Key Questions 1-3 were supported by low or moderate SOE (see Table A):
    - Survival measured in-hospital or at 1-month post incident:
        - No difference in outcomes for all three comparisons in adult/mixed-age patients with cardiac arrest and pediatric patients with cardiac arrest.
        - No difference when BVM was compared with ETI in adult trauma patients.
    - Neurological function measured by the Cerebral Performance Category (CPC), Pediatric CPC, or modified Rankin Scale (mRS) in-hospital or at 1-month post incident:
        - When BVM was compared with SGA, outcomes favored BVM in adult patients with cardiac arrest.
        - When BVM was compared with ETI, there was no difference in outcomes in adult patients with cardiac arrest.

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        - When SGA was compared with ETI, outcomes measured by the CPC favored ETI in adult patients with cardiac arrest; there was no difference in outcomes measured by the mRS in this group.
        - When ETI was compared with BVM or SGA, there was no difference in outcomes in pediatric patients with cardiac arrest.
    - Return of spontaneous circulation (ROSC) (prehospital, sustained, or overall):
        - When BVM was compared with SGA or ETI, there was no difference in outcomes in adult patients.
        - When SGA was compared with ETI, outcomes favored SGA in adult patients.
        - When ETI was compared with BVM or SGA, there was no difference in outcomes in pediatric patients.
    - First-pass successful advanced airway insertion (Key Question 3 only):
        - When SGA was compared with ETI, outcomes favored SGA in adult and pediatric patients with cardiac arrest and adult patients with mixed emergency types.
        - No difference when SGA was compared with ETI in adult patients with medical emergencies.
    - Overall successful advanced airway insertion (Key Question 3 only):
        - No difference when SGA was compared with ETI in adult patients with cardiac arrest, medical, or mixed emergency types.
- For other quantitatively analyzed comparisons and outcomes for Key Questions 1-3, there was insufficient evidence to support conclusions.
- Key findings for comparisons within ETI (Key Question 4):
    - Survival measured in hospital:
        - No difference when rapid sequence intubation (RSI) was compared to ETI with no medication in adult/mixed-age patients with trauma.
    - First-pass successful advanced airway insertion:
        - When RSI was compared to ETI with no medication, RSI was favored in adults/mixed-age patients with mixed emergency types; there was no difference in adults/mixed-age patients with trauma.
        - No difference when video laryngoscopy was compared with direct laryngoscopy in adult/mixed-age patients with cardiac arrest or mixed emergency types.
    - Overall successful advanced airway insertion:
        - When RSI was compared to ETI with no medication, RSI was favored in adults with trauma; there was no difference in adults/mixed-age patients with cardiac arrest or mixed emergency types.
        - No difference when video laryngoscopy was compared with direct laryngoscopy in adult/mixed-age patients with cardiac arrest or mixed emergency types.

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- Implications based on the current body of evidence and finding that no one airway management approach was consistently superior:
  - It is possible all three airway management techniques have a role in prehospital care and the preferred airway approach depends on the setting, patient age and type, available provider expertise, and equipment.
  - Future research should:
    - Focus on rigorous studies, preferably randomized controlled trials (RCTs), given that important and frequent sources of bias in prehospital airway research are difficult to address in observational studies.
    - Construct comparisons that are more clearly defined by specific emergency types, patient groups, and emergency medical service (EMS) resources including training.

Background and Purpose

Emergency medical services care for people who experience emergencies with the goal of stabilizing, treating, and possibly transporting people to emergency departments. A key component of prehospital care is management of the patient's airway followed by ventilation, which is critical to immediate survival and impacts potential recovery.

Three airway management techniques routinely used by EMS include: BVM, SGA, and ETI. Each requires unique training and equipment. Individual research studies, experience with hospitalized patients, and EMS agency resources and personnel experience have led to questions about which prehospital airway management approach is best for what type of patients in specific situations.

Given the complexity of the prehospital environment, many factors are likely to influence patient outcomes, in addition to the airway type. The purpose of this review is to provide a synthesis of the currently available research on the comparative effectiveness of these three airway techniques in prehospital care to help inform EMS practice guidelines and policy.

Methods

We employed methods consistent with those outlined in the Agency for Healthcare Research and Quality Evidence-based Practice Center Program methods guidance (https://effectivehealthcare.ahrq.gov/topics/cer-methods-guide/overview). We identified and synthesized studies published between January 1, 1990 and September 8, 2020. We included studies that compared two types of airways or compared variations of one type of airway, such as video and direct laryngoscopy. Details about our search strategies, inclusion criteria, assessment, and synthesis of the evidence are included in the full report text and appendices.

Our approach and results were specific to characteristics of airway management and research on this topic. A key characteristic was that in prehospital care there are fundamental differences in airway management requirements for trauma, cardiac arrest, and other medical needs. Similarly, the needs and challenges of airway management for

children differ significantly from those for adults. Given these differences, our results were organized into groups defined by age and emergency type. Studies were not combined across these groups, as such combinations would not be clinically meaningful. Pooled estimates were generated separately for RCTs and observational studies; however, the conclusions and SOE assessments presented include all study designs. When there were conflicting findings, we prioritized those from RCTs with low risk of bias

Results

Our results synthesized the findings of 99 studies from 101 publications involving 630,397 patients that compared BVM to SGA (Key Question 1, 22 studies), BVM to ETI (Key Question 2, 22 studies), SGA to ETI (Key Question 3, 41 studies), or compared variations of one of the three airway approaches (Key Question 4, 51 studies). The results for Key Questions 1, 2, and 3 for the outcomes of survival in-hospital or at 1-month post incident, neurological function at discharge or at 1-month post incident, ROSC, and first-pass and overall success are presented in Table A.

The overall findings suggested that there are few differences in primary outcomes between the three methods of airway management studied. Similarly, few differences were found in studies that compared variations of one type of airway (e.g., video versus direct laryngoscopy).

Table A. Overview of conclusions: comparisons by emergency types and age groups

Outcome	Emergency Type and Age	KQ1: BVM vs. SGA	KQ2: BVM vs. ETI	KQ3: SGA vs. ETI
Survival	Cardiac arrest: Adults/Mixed	No difference	**No difference**	No difference
	Cardiac arrest: Pediatrics	No difference[a]	No difference	No difference[a]
	Trauma: Adults	*No conclusion*[a]	No difference	*No conclusion*[a]
	Trauma: Pediatrics	No evidence	*No conclusion*[a]	No evidence
Neurological Function	Cardiac arrest: Adults	mRS: No evidence CPC: Favors BVM	mRS: No evidence CPC: **No difference**	mRS: No difference CPC: Favors ETI[a]
	Cardiac arrest: Pediatrics	*No conclusion*[a]	No difference	No difference[a]
	Trauma: Adults	No evidence	No evidence	No evidence
	Trauma: Pediatrics	No evidence	No evidence	No evidence
ROSC[b]	Cardiac arrest: Adults	No difference	No difference	Favors SGA
	Cardiac arrest: Pediatrics	*No conclusion*[a]	No difference[a]	No difference[a]
First-Pass Success[c]	Cardiac arrest: Adults	NA	NA	Favors SGA
	Cardiac arrest: Pediatrics	NA	NA	Favors SGA[a]
	Trauma: Adults	NA	NA	*No conclusion*[a]
	Trauma: Pediatrics	NA	NA	*No conclusion*[a]
	Medical: Adults	NA	NA	No difference
	Medical: Pediatrics	NA	NA	*No conclusion*[a]
	Mixed: Adults	NA	NA	Favors SGA[a]
	Mixed: Pediatrics	NA	NA	No evidence
Overall Success[c]	Cardiac arrest: Adults	NA	NA	**No difference**
	Cardiac arrest: Pediatrics	NA	NA	No evidence
	Trauma: Adults	NA	NA	*No conclusion*[a]
	Trauma: Pediatrics	NA	NA	No evidence
	Medical: Adults	NA	NA	**No difference**
	Medical: Pediatrics	NA	NA	No evidence
	Mixed: Adults	NA	NA	**No difference**[a]
	Mixed: Pediatrics	NA	NA	No evidence
Harms[d]	All groups	**No difference**	**No difference**	**No difference:** Aspiration, Oral/Airway Trauma, Regurgitation **Favors SGA:** Multiple Insertion Attempts **Favors ETI:** Inadequate Ventilation

BVM = bag valve mask; CPC = Cerebral Performance Category; ETI = endotracheal intubation; KQ = Key Question; mRS = modified Rankin Scale; NA = not applicable; ROSC = return of spontaneous circulation; SGA = supraglottic airway

Bold Text = Moderate SOE, Standard text = Low SOE, Italicized text = Insufficient SOE

[a] Results based only on observational studies
[b] ROSC was only reported in studies of cardiac arrest
[c] Success was qualitatively synthesized for KQ1 and 2; results available in full report
[d] Harms were qualitatively synthesized; meta-analysis not possible as harms are different

Also included in the full report were studies that were analyzed qualitatively, which compared SGA devices, variations on ETI, or reported other outcomes.

Strengths and Limitations

We identified and pooled studies that compared primary outcomes for different types of airway management used in prehospital care. Given the challenges of this environment, the size of the body of evidence was a key strength. It was also useful that most studies included outcomes important to patients and were not limited to process measures that may be less relevant. The most important limitations were weaker observational study designs, rendering them vulnerable to indication and survival biases. Bias, confounding, and incomplete data are difficult to avoid, given the dynamic nature of airway management in the field. Specifically, use of more than one airway approach was common, yet the order, detail, and duration of use was rarely adequately documented and included in analyses. Additionally, the influence of prehospital ventilation was not adequately assessed in the literature, so differences noted in outcomes after various airway management strategies may actually be related to the ventilation provided and not the airway method. Variations within types of airways based on differences in devices and training made generalizations difficult. Finally, there was a lack of evidence focusing on pediatric prehospital airway management.

Conclusion and Implications

Overall, this review found no strongly supported differences in primary outcomes, with most of the results being "no difference" across the three common methods of airway management in prehospital care. Whereas this may be due in part to study limitations, it also may reflect the reality that no one airway approach is consistently more effective across different patient needs and the widely variable prehospital environment. Attempting to derive algorithmic protocols that identify single approach recommendations based solely on effectiveness may not be possible or desirable given this heterogeneity. Future research should focus on rigorous studies, particularly RCTs, given the multiple possible sources of bias and confounding in studies of prehospital airway management that are difficult to address in observational research designs. This research should focus on patient subgroups and factors where there are inconsistencies in the currently available evidence.

Full Report

Carney N, Cheney T, Totten AM, Jungbauer R, Neth MR, Weeks C, Davis-O'Reilly C, Fu R, Yu Y, Chou R, Daya M. Prehospital Airway Management: A Systematic Review. Comparative Effectiveness Review No. 243. (Prepared by the Pacific Northwest Evidence-based Practice Center under Contract No. 290-2015-00009-I.) AHRQ Publication No. 21-EHC023. Rockville, MD: Agency for Healthcare Research and Quality; June 2021. DOI: https://doi.org/10.23970/AHRQEPCCER243. Posted final reports are located on the Effective Health Care Program search page.