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Title: Prehospital supraglottic airway placement by paramedics: Does it improve outcome in paediatric trauma patients?

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Prehospital supraglottic airway placement by paramedics: Does it improve outcome in paediatric trauma patients?

Clinical Scenario

A paramedic crew is dispatched code one to an eight-year-old patient who has fallen from a height of four metres and is now severely dyspnoeic with an altered level of consciousness.

PICO (Population – Intervention – Comparison – Outcome) Question

In paediatric trauma patients, does prehospital supraglottic airway placement by paramedics improve outcome?

Relevance and Rationale of the Question

Paediatric airway management in the prehospital setting is a high-consequence, crucial component of patient treatment, especially in the case of trauma. Paediatric patients have greater oxygen demands and reduced oxygen reserve compared to adults and are therefore less tolerant to interruptions in respiration (Walas et al., 2019). These patients require airway management interventions that ensure adequate oxygenation and ventilation is achieved, to prevent rapid desaturation and subsequent deterioration to respiratory and/or cardiac arrest. Supraglottic airway (SGA) devices are indicated for use in patients unable to maintain airway patency, however, there is a paucity of evidence examining associated outcomes, especially in paediatric trauma patients (Hernandez et al., 2018).

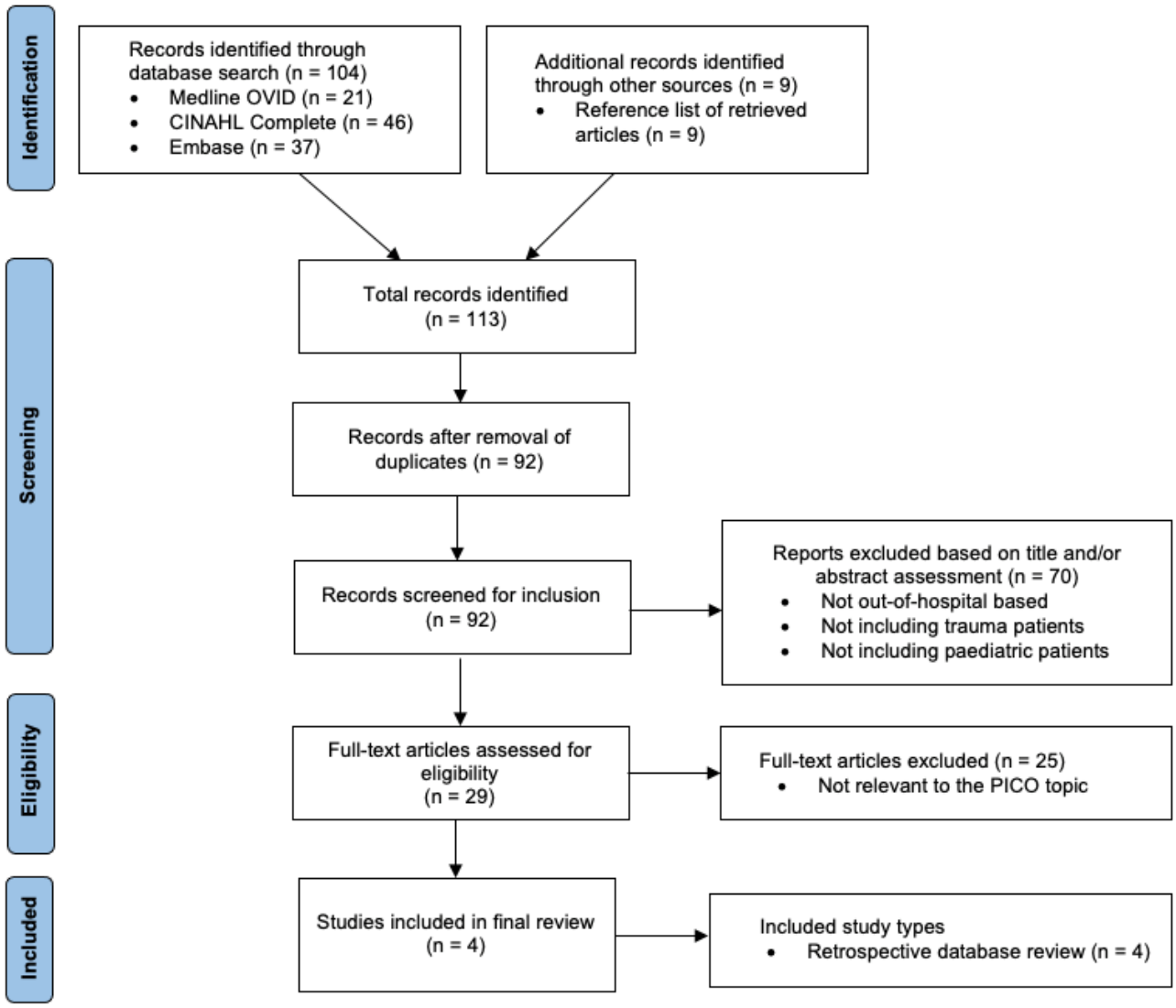
Search Strategy

(“Supraglottic airway” OR SGA OR “laryngeal mask airway” OR LMA OR airway management) AND (prehospital OR pre-hospital OR out of hospital OR "out-of-hospital" OR ambulance* OR "emergency medical services” OR emergency medical technician OR EMS OR paramed*) AND (paediatric OR child*) AND (trauma*) LIMIT TO (January 2016 - September 2021 AND English language AND humans).

Search Outcome

The search identified 113 articles. 29 fulfilled inclusion criteria and four were deemed suitable for review following full-text assessment (Figure 1).

Figure 1. PRISMA flow diagram outlining selection process



Relevant Papers

Author, Year	Study Design & Oxford LOE	Population: Sample, Characteristics	Aim	Results	Strengths (+) & Limitations (-)
Fukuda et al., 2020	Retrospective cohort study LOE: 2b	967 Paediatric patients 1-17 years of age, who received prehospital AAM (SGA or ETI) by EMS personnel during OHCA resuscitation 54.5% of included OHCA's were due to external aetiologies (asphyxia, trauma, etc.)	Identification of whether ETI or SGA placement is associated with increased rates of one-month survival, neurologically favourable survival and prehospital ROSC following paediatric OHCA	No statistically significant difference in one-month survival identified between ETI and SGA groups for patients with an external aetiology of OHCA (6.3% vs 6.8%) No statistically significant differences identified in neurologically favourable survival or prehospital ROSC between ETI and SGA groups ETI insertion associated with a significantly longer ALS time compared to SGA insertion	(+) Data spans across a six-year period (+) Allows for subgroup analysis of the impact of SGA on patients in OHCA due to external causes (e.g., trauma) (-) Lack of generalisability to neonates or infants (-) Retrospective study design (-) Limited number of patients $\leq$ 8 years of age; most municipalities restricted AAM to patients > 8 years (-) No comparison of outcomes with patients who did not receive AAM (-) Information regarding in-hospital and/or post-resuscitation care not available
Ohashi-Fukuda et al., 2017	Retrospective cohort study LOE: 2b	2157 Paediatrics aged < 18 years, excluding neonates and infants (< 1 years), in OHCA from any cause and who received either	Identification of whether prehospital AAM (SGA or ETI) in OHCA is associated with greater rates of overall one-month survival, one-month survival with	No statistically significant difference in one-month survival with favourable neurological status identified between patients receiving AAM compared to BVM alone, although there was a higher	(+) Largest study to compare outcomes of prehospital AAM and BVM ventilation in paediatric OHCA (+) Use of propensity score matching and regression modelling to ensure strong LOE (+) Large sample size

		AAM (SGA or ETI) or BVM ventilation alone • SGA accounted for 91% of AAM interventions 43.4% of patients were in OHCA due to external aetiologies (asphyxia, trauma, etc.) • The largest proportion of the study population according to aetiology	favourable neurological status, and prehospital ROSC, compared to BVM ventilation alone • Neurological status assessed through use of the Glasgow-Pittsburgh CPC scores: favourable status regarded as a score of 1 or 2	frequency of outcome in BVM group (4.6% vs 3.5%) One-month overall survival rates higher in the AAM group (14.7% vs. 10.7%, not statistically significant) Transport time (from patient contact to hospital arrival) longer in AAM group Rate of prehospital ROSC in both AAM and BVM groups was identical	(-) Unable to differentiate outcomes according to the type of AAM used (-) Large difference in proportion of patients receiving BVM compared to AAM (83.1% vs 16.9%) (-) No data obtained regarding the quality of AAM following placement (-) Glasgow-Pittsburgh CPC score used; this score is used for adult population and its correlation to paediatric CPC score is unclear
Hernandez et al., 2017	Retrospective cohort study LOE: 2b	90 Paediatric patients $\leq$ 18 years old with multisystem trauma defined by an ISS $\geq$ 9, and who required prehospital insertion of a SGA device, or prehospital ventilation via BVM with subsequent ETI insertion at hospital	Comparison of adequacy of oxygenation and ventilation between patients receiving a SGA device and patients receiving BVM ventilation with subsequent inpatient ETI insertion • Inadequate oxygenation defined as SpO2 <	Patients who received a SGA device experienced: • A greater frequency of inadequate oxygenation and ventilation • Higher rates of rescue tracheostomy (31% vs 8%) • Higher rates of 24-hour mortality (38% vs 10.8%)	(+) First study to compare prehospital SGA and BVM ventilation among paediatric trauma patients (+) Entirely specific to the topic under investigation (-) Only one type of SGA was used (-) Single-centre study (-) Very small sample size & retrospective study design

			92% or PaCO2 > 45 mmHg Secondary outcomes including overall mortality rates and ICU LOS were analysed	• Higher rates of overall mortality (75% vs 14%) • Longer average ICU LOS (3 days vs 2 days) • Higher frequency of prehospital airway complications	(-) Large difference in proportion of patients receiving prehospital BVM compared to prehospital SGA (81% vs 19%) (-) Adult trauma team managed older adolescents (15–17 years) - conventional practice of early tracheostomy in patients arriving with a SGA in-situ
Okubo et al., 2019	Retrospective cohort study LOE: 2b	3801 Paediatrics aged < 18 years in OHCA from any cause on whom resuscitation was attempted by EMS personnel 44% of examined OHCA due to traumatic aetiology	Identification of the impact of prehospital AAM (SGA or ETI) on overall one-month survival and one-month survival with favourable functional status when compared to prehospital resuscitation without use of AAM • Favourable functional status expressed as a CPC score of 1 or 2	Patients receiving SGA did not experience statistically significant differences in 1-month survival compared to no AAM (11.6% vs 9.1%) SGA patients experienced statistically similar rates of 1-month survival with favourable functional status compared to no AAM (2.3% vs 1.5%)	(+) Propensity score and risk-set matching analysis to adjust for confounding factors (+) Large sample size (+) Stratified analysis allows for comparison between type of AAM and outcomes (-) Adult CPC score used (-) Patient co-morbidities and premorbid function were not accounted for (-) No subgroup analysis between traumatic and non-traumatic aetiologies of OHCA

Abbreviations: AAM; advanced airway management, ALS; advanced life support, BVM; bag-valve-mask, CPC; cerebral performance category, ETI; endotracheal intubation, EMS; emergency medical service, ICU; intensive care unit, ISS; injury severity score, LOE; level of evidence, LOS; length of stay, OHCA; out-of-hospital cardiac arrest, ROSC; return of spontaneous circulation, SGA; supraglottic airway

Comments

The available literature suggests that prehospital SGA devices achieve statistically similar outcomes to bag-valve-mask ventilation and/or endotracheal intubation in paediatric trauma patients. Namely, comparable rates of overall one-month survival, neurologically favourable survival and prehospital return of spontaneous circulation have been identified. These articles, however, are mostly associated with traumatic out-of-hospital cardiac arrests, and many fail to address outcomes in other situations. Whilst one study identified a greater frequency of inadequate oxygenation and ventilation with SGA use, and therefore poorer patient outcomes, findings of this study lacked internal validity and were difficult to extrapolate. It is, however, important to note that SGA placement by paramedics is often associated with prolonged treatment times, which may be detrimental to patients requiring urgent, definitive care at hospital. However, further studies are required to address this variable.

Consider

Based on the relevant studies identified, a change in practice is not recommended. There is a significant lack of evidence examining the impact that SGA placement by paramedics has on paediatric trauma patient outcomes, and therefore, it is important that further, high-quality research is conducted to advance paramedic practice. Whilst SGA devices may not be associated with improved patient outcome, they are considered to have advantages over bag-valve-mask ventilation alone with regard to airway protection and capnography accuracy, and therefore still have their place within the out-of-hospital setting (Newell et al., 2018). As clinicians, it is important that paramedics are mindful to implement airway management techniques that address clinical needs and that circumvent as many complications as possible.

Clinical bottom line

The prehospital placement of supraglottic airways by paramedics is not associated with improved outcome in paediatric trauma patients, however, further literature is required to warrant a change in clinical practice.

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