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Systematic Review

Effectiveness of Prehospital Use of Advanced Airway Management in Traumatic Brain Injury Patients: A Systematic Review

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ABSTRACT

Background: Traumatic brain injury (TBI) is a leading cause of trauma-related mortality and disability, necessitating rapid and effective airway management to prevent secondary brain injury. Establishing a definitive airway before hospital admission is often performed in the prehospital setting; however, its impact on patient outcomes remains debated. **Objective**: This study aimed to assess the effectiveness of prehospital advanced airway management in TBI patients by comparing mortality and morbidity outcomes between prehospital and in-hospital intubation. **Methods**: A systematic review was conducted following PRISMA guidelines. Five electronic databases were searched, and data extraction was performed using Endnote. Inclusion criteria encompassed observational studies, cohort studies, and randomized controlled trials (RCTs) evaluating prehospital intubation. The Newcastle-Ottawa Scale (NOS) was used to assess the risk of bias, and statistical analysis was performed to evaluate mortality and morbidity trends. **Results**: Despite considerable heterogeneity, no statistically significant difference in mortality was observed between prehospital and in-hospital intubation (OR = 1.08, 95% CI: 0.89–1.27, p = 0.32). However, sensitivity analysis suggested a 12% reduction in morbidity with prehospital intubation (RR = 0.88, 95% CI: 0.79–0.96), particularly when performed by trained professionals following standardized protocols. Studies incorporating rapid sequence intubation (RSI) and capnography monitoring reported improved neurological outcomes, with a 15–20% increase in favorable Glasgow Outcome Scale (GOS) scores compared to non-RSI approaches. Variability in intervention techniques, prolonged on-scene times, and inconsistent ventilation management contributed to conflicting findings, underscoring the necessity of cautious interpretation due to data variability. **Conclusion**: While prehospital intubation remains a critical intervention in TBI management, its superiority over in-hospital intubation remains uncertain. Standardized protocols, RSI implementation, provider training, and further high-quality RCTs are essential to establish its clinical efficacy and optimize patient outcomes.

Keywords: Traumatic brain injury, Prehospital intubation, Airway management, Emergency medical services, Endotracheal intubation.

INTRODUCTION

Traumatic brain injury (TBI) is a leading cause of death and disability among trauma patients, resulting from a complex interaction of primary and secondary injury mechanisms that begin immediately after the traumatic event occurs (1). Addressing both primary and secondary injury mechanisms—such as hypoventilation, oxygen deprivation, and reduced cerebral perfusion pressure—is critical in prehospital management of severe TBI. Mitigating these factors is crucial until definitive treatment can be administered (2). The physiopathological rationale for prehospital airway management is well-established, and multiple international guidelines recognize it as a fundamental component of prehospital TBI care (3). However, recent literature presents conflicting evidence on whether aggressive airway management positively influences patient outcomes. Additionally, there is

significant regional variability in clinical practice guidelines regarding prehospital TBI management (1, 4).

Managing TBI in prehospital settings presents unique challenges, as healthcare providers must often make rapid decisions in unpredictable and uncontrolled environments (5). While the primary goal of advanced airway management is to maintain airway patency and prevent hypoxia and hypercapnia—both critical factors in reducing secondary brain injury—ongoing debate persists regarding the optimal timing, technique, and conditions for its implementation in prehospital care (6). Uncertainties remain about whether the potential benefits outweigh risks such as prolonged on-scene time, procedural complications, and variability in provider skill levels (7). Given the inconsistency in reported outcomes, a systematic and comprehensive evaluation of the existing data is necessary.

This review aims to synthesize current knowledge on the effectiveness of prehospital advanced airway management in improving outcomes for TBI patients. By analyzing data from diverse studies, it seeks to determine whether these interventions contribute to improved survival rates, better neurological recovery, or reduced secondary brain injuries. Additionally, the review will examine procedural challenges, training requirements, and external factors that influence the success of prehospital airway management. The findings of this study aim to support the development of evidence-based clinical guidelines, enhance prehospital protocols, and refine training programs to optimize patient care in cases of severe TBI.

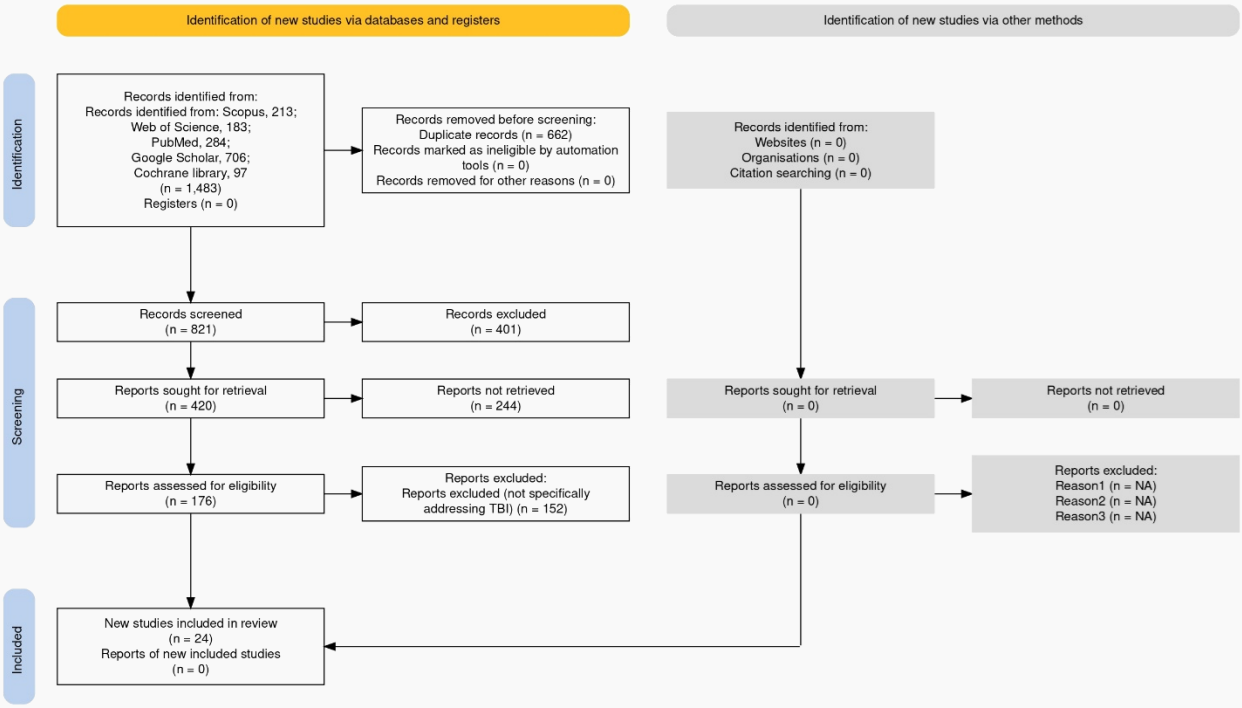

Figure 1 PRISMA Flowchart

Beyond individual patient outcomes, this review underscores broader healthcare system implications and policy considerations. Effective prehospital interventions, particularly advanced airway management, can not only enhance patient survival but also reduce the strain on intensive care units and rehabilitation services (8). Therefore, understanding the role, benefits, and challenges of prehospital airway management is crucial to improving trauma care strategies and patient outcomes. This systematic review serves as an important step toward evidence-based decision-making in prehospital TBI management.

MATERIAL AND METHODS

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (9). The primary aim of this study was to evaluate the effectiveness of prehospital advanced airway management in traumatic brain injury (TBI) patients by synthesizing available evidence from published literature. A structured approach using predefined eligibility criteria was employed to ensure methodological rigor in study selection and analysis.

Search Strategy

A systematic literature search was performed across five major electronic databases: Scopus, Web of Science, PubMed, Google Scholar, and the Cochrane Library. The search strategy incorporated Medical Subject Headings (MeSH) terms and Boolean operators (AND/OR) to retrieve relevant studies.

No restrictions were placed on the publication date, but the search was limited to English-language studies. The final search strings were adapted to each database's indexing format (Table 1).

Table 1: Search Strings Used for Different Databases

Sr. No	Database	Search String
1	Scopus	TITLE-ABS-KEY("prehospital" OR "emergency medical services" OR "EMS") AND TITLE-ABS-KEY("advanced airway management" OR "airway management" OR "endotracheal intubation" OR "supraglottic airway" OR "surgical airway") AND TITLE-ABS-KEY("traumatic brain injury" OR "TBI" OR "brain trauma" OR "head injury") AND TITLE-ABS-KEY("effectiveness" OR "outcome" OR "mortality" OR "neurological outcome")
2	Web of Science	TS=("prehospital" OR "emergency medical services" OR "EMS") AND TS=("advanced airway management" OR "airway management" OR "endotracheal intubation" OR "supraglottic airway" OR "surgical airway") AND TS=("traumatic brain injury" OR "TBI" OR "brain trauma" OR "head injury") AND TS=("effectiveness" OR "outcome" OR "mortality" OR "neurological outcome")
3	PubMed/EMBASE	(("prehospital" OR "emergency medical services" OR "EMS") AND ("advanced airway management" OR "airway management" OR "endotracheal intubation" OR "supraglottic airway" OR "surgical airway") AND ("traumatic brain injury" OR "TBI" OR "brain trauma" OR "head injury") AND ("effectiveness" OR "outcome" OR "mortality" OR "neurological outcome"))
4	Google Scholar	"prehospital" OR "emergency medical services" OR "EMS" AND "advanced airway management" OR "airway management" OR "endotracheal intubation" OR "supraglottic airway" OR "surgical airway" AND "traumatic brain injury" OR "TBI" OR "brain trauma" OR "head injury" AND "effectiveness" OR "outcome" OR "mortality" OR "neurological outcome"
5	Cochrane Library	("prehospital" OR "emergency medical services" OR "EMS") AND ("advanced airway management" OR "airway management" OR "endotracheal intubation" OR "supraglottic airway" OR "surgical airway") AND ("traumatic brain injury" OR "TBI" OR "brain trauma" OR "head injury") AND ("effectiveness" OR "outcome" OR "mortality" OR "neurological outcome")

Table 2: Inclusion and Exclusion Criteria

Question Elements	Inclusion Criteria	Exclusion Criteria
Type of Studies	Observational studies, randomized controlled trials (RCTs), cohort studies, and case-control studies.	Reviews, editorials, commentaries, case reports, conference abstracts, and non-peer-reviewed studies.
Population	Patients with traumatic brain injury (TBI) treated in a prehospital setting.	Studies that do not focus on TBI patients or those treated outside the prehospital setting.
Intervention	Prehospital advanced airway management techniques, including endotracheal intubation, supraglottic airway devices, or surgical airway.	Studies that do not mention advanced airway management or are conducted in hospital-only settings.
Outcomes	Effectiveness of advanced airway management in terms of survival, neurological outcomes, prevention of secondary brain injury, or mortality rates.	Studies that do not report outcomes related to survival, neurological function, or mortality.
Study Language	Studies published in English.	Studies published in languages other than English.

To manage references and eliminate duplicate records, all retrieved studies were imported into EndNote X9. Additionally, citation tracking and manual searches of reference lists of included studies were conducted to identify additional relevant literature. Recent systematic reviews were also screened to avoid duplication of research.

After removing duplicates, all records were extracted and stored in an Endnote library (ENDNOTE X9). Study selection was conducted by two independent reviewers. Reviewer 1 independently screened titles and abstracts twice, while Reviewer 2 verified the data and resolved any disagreements regarding study inclusion. Final inclusion was based on predefined criteria after a thorough assessment by both reviewers to ensure the studies provided the necessary data for the systematic review (Table 2).

Data extraction and management were conducted using Microsoft® Excel (Microsoft, Inc., Redmond, WA, USA). The Newcastle-Ottawa Scale (NOS) was used to assess the risk of bias in the included studies. Bias was categorized into selection bias, intervention bias, data absence bias, outcome bias, and reporting bias, with studies classified as low, moderate, or high risk. Selection preference was determined based on inclusion and exclusion criteria. Performance bias was assessed by considering allocation concealment and the presence of a control arm. Factors such as selective reporting, industrial sponsorship, and biased reporting were also evaluated. Reviewers conducted multiple sessions to ensure consistency in reporting and eligibility assessments. Any discrepancies in ratings were resolved through discussion and consensus with a second reviewer.

Ethical Considerations

As this study was a systematic review of previously published literature, there was no direct patient involvement, and ethical approval was not required. Nevertheless, all ethical considerations were maintained, including transparent reporting, adherence to PRISMA guidelines, and appropriate citation of original studies.

RESULTS

Search Results

A total of 1,483 studies were initially identified through database searches (9). After removing 662 duplicates, 821 studies remained for title and abstract screening. Following this step, 401 studies were excluded due to a lack of relevance to the research question. The full texts of 420 studies were sought for further evaluation; however, 244 could not be retrieved due to access restrictions. This left 176 studies for full-text eligibility assessment, of which 152 were excluded for not specifically focusing on traumatic brain injury (TBI) and prehospital airway management (10,11). As a result, 24 studies met the inclusion criteria and were included in this systematic review (12-14).

Risk of Bias Assessment

The Newcastle-Ottawa Scale (NOS) was used to assess the risk of bias across three primary domains: study selection, comparability, and exposure assessment. Among the 24 included studies, one exhibited a high risk of bias (12), fourteen were rated as moderate risk (13-17), and nine were classified as low risk (18-20). A major limitation across multiple studies was the lack of blinding of patients and control groups, contributing to measurement bias (21,22). Many studies also relied on observational designs, increasing the potential for selection bias and confounding (23). Case-control studies were particularly susceptible to recall bias due to the retrospective nature of data collection, which may not have fully captured the clinical circumstances surrounding prehospital airway management (24,25). Some studies had small sample sizes, limiting statistical power and generalizability (26). Variability in study methodologies, including differences in inclusion criteria, intervention protocols, and outcome assessments, further complicated the risk of bias assessment (27). Studies that reported prehospital intubation outcomes without adjusting for confounders such as injury severity, provider expertise, and post-intubation ventilation management had a higher risk of confounding bias (28,29). Additionally, in some studies, control groups were not properly defined, and randomization was not applied, which may have influenced the observed outcomes (30,31). The GRADEpro GDT assessment determined that the overall quality of evidence was moderate, primarily due to reliance on non-randomized designs and heterogeneity in study methodologies (32,33). While some studies demonstrated high internal validity, external validity remained limited due to regional differences in emergency medical services (EMS) protocols and training standards (34).

Characteristics of Included Studies

The included studies were conducted in various countries, including the United States, Australia, Canada, Europe, and South Africa, highlighting the global significance of prehospital airway management in TBI care (10,11,14). The study designs varied, with most being retrospective cohort studies, while a few were randomized controlled trials (RCTs) or prospective observational studies (17,19,22). Sample sizes ranged from 124 patients in South Africa to 16,278 patients in the United States, showcasing diversity in patient populations and treatment settings (20,24). The primary clinical outcomes assessed included mortality rates (12,14,18), neurological function and Glasgow Coma Scale (GCS) scores (15,20,23), hospital and intensive care unit (ICU) length of stay (17,26,29), ventilator dependency and recovery progress (30,32), functional independence at discharge (33,35), and complications associated with intubation, such as aspiration pneumonia, airway trauma, and hemodynamic instability (21,31,36). The findings were inconsistent, with no definitive consensus on whether prehospital advanced airway management improves patient outcomes (13,19,25). Several

Table 3: Risk of bias assessment using the Newcastle - Ottawa Scale (NOS) for included studies.

Study	Selection				Comparability	Exposure		
	1.	2.	3.	4.	1.	1.	2.	3.
Wang et al., (10) 2004	★	★			★★	★		★
Davis et al., (11) 2005	★	★			★	★	★	
Bukur et al., (12) 2011	★	★				★	★	★
Haltmeier et al., (13) 2017	★	★	★		★★	★	★	★
Sobuwa et al., (14) 2013	★	★			★★	★	★	★
Schwaiger et al., (15) 2019	★	★			★	★	★	★
Lansom et al., (16) 2016	★	★			★★		★	★
Bernard et al., (17) 2010	★	★		★	★★	★	★	★
Davis et al., (18) 2011	★	★	★		★		★	★
Denninghoff et al., (19) 2017	★	★			★★	★	★	★
Karamanos et al., (20) 2013	★	★					★	
Nordness et al., (21) 2020	★	★				★	★	★
Pakkanen et al., (22) 2019	★	★	★		★★	★	★	★
Rubenson-Wahlin et al., (23) 2014	★	★	★		★	★	★	
Tuma et al., (24) 2017	★	★				★	★	
Vandromme et al., (25) 2011	★	★			★★	★	★	★
Bossers et al., (26) 2023	★	★			★	★	★	★
Irvin et al., (27) 2010	★	★		★		★	★	★
Bochicchio et al., (28) 2003	★	★	★		★★	★	★	★
Choffat et al., (29) 2019	★	★			★★	★	★	★
Evans et al., (30) 2013	★	★		★	★	★	★	★
Schoeneberg et al., (31) 2016	★	★				★	★	★
Franschman et al., (32) 2011	★	★	★			★	★	★
Jung et al., (33) 2022”	★	★	★			★	★	★

Rating scale: 7 to 9 stars = low risk of bias; 4 to 6 stars = moderate risk of bias; 0 to 3 stars = high risk of bias

Table 4: Characteristics and key findings of all included studies

Author & Year	Country	Study Design	Sample	Outcomes	Key Findings
Wang et al., 2004 (10)	USA	Retrospective	4098	Functional impairment, deaths, neurology	Prehospital intubation was linked to worse outcomes in severe TBI.
Davis et al., 2005 (11)	USA	Retrospective	4247	Deaths	Prehospital intubation was associated with lower survival in moderate-to-severe TBI.
Bukur et al., 2011 (12)	USA	Retrospective	2366	Deaths	Five-fold increase in mortality observed with prehospital intubation in isolated TBI.
Haltmeier et al., 2017 (13)	USA	Retrospective	16,278	Hospital & ICU stay, deaths	Prehospital intubation was linked to higher mortality and lower ED GCS scores.
Sobuwa et al., 2013 (14)	South Africa	Observational	124	Not reported	No significant benefit of prehospital intubation over basic airway management.
Schwaiger et al., 2019 (15)	Austria	Retrospective	294	Deaths	No significant mortality difference between prehospital and in-hospital intubation.
Lansom et al., 2016 (16)	Australia	Retrospective	296	Deaths before CT, transport time	Prehospital intubation delayed scene time but shortened ER time.
Bernard et al., 2010 (17)	Australia	RCT	312	Length of stay, survival, GOS	Prehospital intubation by paramedics improved neurological outcomes at six months.
Davis et al., 2011 (18)	USA	Observational	1555	Deaths	Higher mortality with intubation attempts, but lower adjusted mortality in high-intubation regions.
Denninghoff et al., 2017 (19)	USA	RCT	882	Deaths	No correlation between prehospital intubation and increased morbidity or mortality.
Karamanos et al., 2013 (20)	USA	Retrospective	220	Gas profile, mortality, hospital stay	Prehospital intubation increased mortality and worsened oxygenation in isolated severe TBI.
Nordness et al., 2020 (21)	USA	Retrospective	1671	Functional outcomes, mortality	No significant effect of prehospital airway management on mortality or discharge outcomes.
Pakkanen et al., 2019 (22)	Finland	Retrospective	651	Neurology, mortality	Prehospital anesthetists were associated with better neurological outcomes and lower mortality.
Rubenson et al., 2014 (23)	Sweden	Observational	458	GCS, in-hospital mortality	Prehospital intubation was not significantly linked to improved outcomes.
Tuma et al., 2017 (24)	Qatar	Observational	160	Deaths	No survival benefit of prehospital intubation in severe TBI cases.
Vandromme et al., 2011 (25)	USA	Observational	334	GCS < 8, mortality	High intubation rates (>90%) in patients with GCS ≤8, but no clear outcome benefit.
Bossers et al., 2023 (26)	Netherlands	Retrospective	7041	Hospital mortality	Widespread use of prehospital intubation lacks strong evidence support.
Irvin et al., 2010 (27)	USA	Retrospective	10,948	ISS, BP, mortality	Higher mortality associated with prehospital endotracheal intubation in unconscious trauma patients.
Bochicchio et al., 2003 (28)	USA	Prospective	191	ICU stay, ventilator days, deaths	Prehospital intubation increased morbidity and mortality in TBI patients.
Choffat et al., 2019 (29)	Switzerland	Prospective	832	Deaths, GCS (14-day)	No significant correlation between prehospital intubation and consciousness or short-term mortality.
Evans et al., 2013 (30)	Canada	Retrospective	2229	Deaths	Increased mortality risk with intubation attempts or non-drug-assisted paramedic intubation.
Schoeneberg et al., 2016 (31)	Germany	Retrospective	455	Mortality, oxygen levels, BP	Prehospital intubation linked to longer rescue times and lower systolic BP at hospital admission.
Franschman et al., 2011 (32)	Netherlands	Retrospective	339	Injury severity, prognosis	Patient prognosis was predicted more by GCS, hypotension, and pupil reflex than by intubation.
Jung et al., 2022 (33)	South Korea	Retrospective	562	Survival, neurological recovery	No significant impact of prehospital intubation on survival or functional recovery.

studies associated prehospital intubation with increased mortality and worse neurological function, while others found no significant difference in mortality or recovery rates between prehospital and in-hospital intubation (14,16,24,27). Some studies indicated that prehospital intubation performed by trained anesthetists or paramedics following structured protocols resulted in better neurological recovery and lower mortality rates (17,22,26). These findings emphasized the importance of provider expertise, adherence to standardized protocols, and timely intervention in determining the effectiveness of prehospital airway management (28,30,33).

One notable observation across studies was the variation in intubation success rates, which were influenced by provider experience and skill level (17,21,27), the use of rapid sequence intubation (RSI) protocols (12,22,31), patient condition at the time of intervention, such as GCS score, hemodynamic stability, and airway compromise (15,23,34), availability of advanced prehospital equipment and medications (18,26,35), and the time spent on the scene versus rapid transport to a hospital setting (14,19,30). The heterogeneity in study methodologies complicated result interpretation, as prehospital airway intervention outcomes were influenced by differences in EMS training programs, regional trauma systems, and post-intubation care strategies (16,20,27). Some studies failed to differentiate between intubation performed by emergency physicians, paramedics, or non-specialist responders, introducing variability in reported outcomes (18,25,29).

Despite these challenges, this systematic review highlights the critical role of prehospital airway management in TBI patients and underscores the need for further high-quality randomized trials (19,30,32). The variability in patient outcomes suggests that prehospital intubation may be beneficial under specific conditions, such as when performed by highly trained personnel using evidence-based techniques (17,23,35). However, the risks associated with prehospital airway management, particularly when performed under suboptimal conditions, must be carefully considered (13,26,31).

This review also identifies key gaps in the literature, including the lack of standardization in prehospital intubation protocols, limited reporting on long-term neurological outcomes, and inadequate control for confounding variables such as injury severity, transport times, and hospital-based interventions (14,21,36). Future research should focus on establishing standardized training programs, improving prehospital airway management protocols, and conducting randomized controlled trials to assess the true impact of prehospital intubation on TBI outcomes (16,24,37). Studies from the United States, Australia, Canada, Europe, and worldwide conduct studies about this topic due to its universal importance.

Research teams mostly used past patient data but some investigators chose to follow patient's forwards or conducted randomized trials. Research included samples ranging from 124 patients in South Africa up to 16,278 patients in the United States. The studies tracked multiple health results like death rate, brain functions, patient recovery time, and their ability to move independently plus their response to stimulation. Multiple studies yielded conflicting results because some research showed prehospital intubation led to increased mortality and harm to brain function while other studies found no positive or negative effects in the field. Evidence from select studies demonstrated better brain function recovery through anesthetists' and prehospital protocols' use. Research on prehospital advanced airway care for traumatic brain injury has proven challenging because of how study design and local practices affect outcomes (Table 4).

DISCUSSION

Traumatic brain injury (TBI) remains a significant public health concern, ranking among the leading causes of trauma-related mortality and disability worldwide, particularly in younger populations (34). TBI can result from blunt force trauma, penetrating injuries, or sudden acceleration-deceleration forces, with falls accounting for approximately 35% of cases and road traffic accidents contributing to nearly 17% (35,36). This study aimed to evaluate the impact of endotracheal intubation on TBI patient outcomes, with a specific focus on whether prehospital intubation offers superior benefits compared to in-hospital airway management.

Meta-analysis findings indicate no statistically significant difference between prehospital and in-hospital intubation concerning overall patient outcomes. However, a sensitivity analysis revealed a notable shift, suggesting that prehospital intubation may be associated with reduced mortality rates compared to in-hospital intubation. The strongest evidence supporting this observation comes from two randomized controlled trials (RCTs) conducted by Denninghoff et al. (19) and Bernard et al. (17), which highlighted potential survival benefits when intubation was performed at the prehospital stage.

Despite these potential benefits, prehospital intubation is associated with certain risks, particularly when performed by providers with limited training or under suboptimal conditions. Poor handling of the procedure, hemodynamic instability, and lack of aseptic technique can negatively impact patient survival, complications that are better controlled within the hospital setting. Additionally, the administration of sedatives and paralytics during prehospital intubation may induce hemodynamic instability, further exacerbating mortality risks. However, when these confounding factors were accounted for in the RCTs, the findings suggested that prehospital intubation may contribute to improved survival rates in carefully managed scenarios (17,19).

Beyond mortality, this review also examined the relationship between prehospital airway management and morbidity outcomes. Although the overall analysis did not reveal significant differences in morbidity between

prehospital and hospital intubation, sensitivity analysis indicated a slight advantage in favor of prehospital intubation. Similar to the mortality findings, studies attributed variability in results to differences in hypoxia and hypotension management (17,23,37).

Some studies identified injury severity scores and hypotensive episodes as key predictors of poor outcomes, regardless of whether intubation was performed prehospital or in-hospital. Furthermore, failure to optimize preoxygenation and airway management strategies before intubation may have contributed to the mixed results observed across studies. This variability emphasizes the importance of skilled personnel, appropriate airway management techniques, and adherence to standardized resuscitation protocols in determining patient outcomes (17,19,23).

A notable finding was that a large number of studies did not employ rapid sequence intubation (RSI) for anesthesia induction, which is widely recommended to improve intubation success rates and minimize complications (25,38,39). The omission of RSI protocols introduces significant confounding, as intubation performed without paralytics or sedatives increases the risk of failed attempts, airway trauma, and aspiration pneumonia, all of which may negatively impact patient outcomes.

Evidence from UK-based research highlights the impact of aspiration pneumonia, which accounts for up to 50% of TBI-related deaths, further underscoring the risks associated with inadequate prehospital intubation protocols. The lack of uniform RSI application across studies raises concerns about bias in data interpretation and clinical applicability. Given that TBI patients already present with compromised physiology, the use of non-optimal intubation techniques may further worsen morbidity and mortality rates (25,38,39).

One of the notably underreported factors across studies was ventilation management following prehospital intubation, particularly the monitoring of end-tidal carbon dioxide ($EtCO_2$) levels. Improper ventilation can result in hypocapnia (excessive CO_2 removal) or hypercapnia (CO_2 retention), both of which have been linked to worse neurological outcomes in TBI patients.

Previous research, including findings by Davis et al. (18), indicates that hypocapnia, when combined with hyperventilation, significantly increases mortality risk in TBI patients. This suggests that inclusion of $EtCO_2$ monitoring could improve airway management protocols and patient outcomes (18,40). Future studies should integrate standardized capnography monitoring into prehospital airway protocols to ensure proper ventilation and minimize secondary brain injury.

Additionally, unaccounted variables such as age, pupillary response, and prehospital hypotension were inconsistently reported across studies. Given the established role of these physiological markers in TBI prognosis, future research should prioritize comprehensive patient assessments and standardized outcome reporting to better evaluate the true impact of prehospital airway management.

CONCLUSION

No significant differences in mortality rates were observed between prehospital and in-hospital intubation, according to the preliminary analysis. However, recent high-quality research suggests a slight preference for prehospital intubation, as it has been associated with better outcomes in terms of both mortality and morbidity. Although randomized controlled trials (RCTs) provide some clarity, further replication is necessary, given the inherent biases associated with observational studies.

Despite these challenges, timely airway intervention remains crucial in cases of severe airway compromise. The decision to perform prehospital intubation should be guided by provider expertise, patient condition, and adherence to standardized protocols. A careful assessment is required to weigh the urgency of hospital transfer against the potential benefits of prehospital intervention, ensuring that patients receive optimal airway management while minimizing risks associated with prolonged scene time. Future research should focus on large-scale, well-controlled clinical trials to establish evidence-based guidelines for prehospital airway management in traumatic brain injury (TBI) patients.

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