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Protocol for a systematic review on effective patient positioning for rapid sequence intubation

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ABSTRACT

Introduction Rapid sequence intubation (RSI) is an advanced airway technique to perform endotracheal intubation in patients at high risk of aspiration. Although RSI is recognised as a life-saving technique and performed by many physicians in various settings (emergency departments, intensive care units), there is still a lack of consensus on various features of the procedure, most notably patient positioning. Previously, experts have commented on the unique drawbacks and benefits of various positions and studies have been published comparing patient positions and how it can affect endotracheal intubation in the context of RSI. The purpose of this systematic review is to compile the existing evidence to understand and compare how different patient positions can potentially affect the success of RSI.

Methods and analysis We will use MEDLINE, EMBASE and the Cochrane Library to source studies from 1946 to 2021 that evaluate the impact of patient positioning on endotracheal intubation in the context of RSI. We will include randomised control trials, case–control studies, prospective/retrospective cohort studies and mannequin simulation studies for consideration in this systematic review. Subsequently, we will generate a Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram to display how we selected our final studies for inclusion in the review. Two independent reviewers will complete the study screening, selection and extraction, with a third reviewer available to address any conflicts. The reviewers will extract this data in accordance with our outcomes of interest and display it in a table format to highlight patient-relevant outcomes and difficulty airway management outcomes. We will use the Risk of Bias tool and the Newcastle-Ottawa Scale to assess included studies for bias.

Ethics and dissemination This systematic review does not require ethics approval, as all patient-centred data will be reported from published studies.

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INTRODUCTION

During traditional elective surgeries requiring intubation, patients are fasted to prevent pulmonary aspiration. This is of particular importance during induction and intubation, as the administration of neuro-muscular blockade prevents any protective gag reflexes, making the airways especially

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STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ A comprehensive search of existing databases does not show any current systematic reviews evaluating the impact of patient positioning on rapid sequence intubation.
⇒ This review will report patient-centred outcomes that are clinically relevant. In addition, this review will also report outcomes associated with difficult airway management which will be important for physicians who are required to intubate patients.
⇒ The limited exclusion criteria in this review will allow for a broad selection of papers to be considered for the full-text review stage.
⇒ We anticipate most of the studies in the full-text review will be studies involving mannequin simulation scenarios.

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vulnerable to aspiration.[1 2] In an emergent patient requiring immediate intubation, the healthcare providers encounter the possibility of intubating a patient with a full stomach, which can have severe life-threatening complications. Rapid sequence intubation (RSI) is an advanced airway technique to achieve endotracheal intubation in patients at high risk of aspiration.[3] Despite RSI originating as an operating room procedure, its practice has extended to emergency departments (ED), intensive care units (ICUs) and prehospital settings[4–6] and is often performed by physicians other than anaesthesiologists. Despite RSI's prevalence and recognition as a life-saving procedure, there are still several features of the RSI methodology that are controversial and lack consensus.[3 4]

Recently, there have been systematic reviews to elucidate how various components of RSI influence safety and patient outcomes, which are crucial in refining the RSI procedure. Systematic reviews on RSI have investigated the role of specific induction agents,[7] compared the efficacy of different paralytics and the ideal doses,[8 9] and the effectiveness of applying cricoid pressure.[10] These are crucial aspects of RSI, however, a feature of RSI that

would benefit from a review of the current available evidence is patient positioning and how this contributes to safety and patient outcomes.

Patient positioning in anaesthesia can contribute to the ease or difficulty of intubation and have substantial effects on a patient's physiology, such as their ventilation and haemodynamics.[11] The supine position is most commonly used to anaesthetise patients because of its ease of intubation, despite some compromise in ventilation abilities as the abdominal contents move superiorly compressing lung volumes.[3 6 11] Despite its prevalence under standard conditions there is controversy over its use in RSI as there is an increased risk of gastric aspiration in this position—gastric contents do not have to work against gravity to escape the upper oesophagus—potentially making this a less favourable position for RSI.[11 12] Considering this, healthcare practitioners have explored other patient positions with their own unique drawbacks and benefits. For instance, the head-down (Trendelenburg) position may be beneficial in RSI since gravity redirects gastric contents away from the trachea should regurgitation occur. However, this potential benefit may come at the cost of a difficult view and ventilation being further compromised (relative to the supine position) as abdominal contents compress lung volume.[3 11 13]

The controversy over patient positioning in RSI is well recognised within the medical literature.[3 4] Furthermore, the risk of aspiration during RSI (0.5%–2.8%) remains relatively high when compared with standard conditions (0.01%–0.04%).[14] A systematic review which summarises the current evidence-based understanding on the effectiveness of patient positions can inform clinical practice and provide a footing for further research and innovation in this field.

AIMS
The purpose of this systematic review is to evaluate the effect of different patient positions in the context of RSI on patient safety outcomes and procedural outcomes.

METHODOLOGY
The PICO strategy is outlined below in table 1. We used the Preferred Reporting Items for Systematic Review and Meta-Analyse Protocol (PRISMA) guidelines to guide the development of this systematic review protocol.[15]

Types of studies
Study designs will include randomised controlled trials, prospective and retrospective observational cohort studies, and case–control studies, which can each involve mannequins or human participants. To the best of our knowledge, there are no systematic reviews investigating patient positioning in the context of RSI and its impact on intubation procedure, safety and patient outcome(s). There are no restrictions with regard to the sample size or publication date of the studies. The end date of screening will be on 24 November 2021. Only studies published in English will be included.

Types of participants
Inclusion criteria
1. Adult (≥ 18 years) patients.
2. RSI or emergent intubation.
3. Intubation procedures done by physician anaesthesiologists, anaesthetic trainees, emergency physicians, critical care physicians and medical learners.

Exclusion criteria
1. Paediatric patients.
2. Studies in languages other than English.
3. The specialty of the physician performing RSI differs between intervention and control group.

Types of intervention
Interventions of interest will include the following non-exhaustive list of patient positions: Trendelenburg (head down) position, reverse Trendelenburg (head-up) position, semierect position, supine position and ramped positions at differing angles.

Comparator
We expect that many studies have used the supine position as a comparator, however, we do not anticipate all studies to have done this and suspect some may have compared two non-conventional patient positions with each other. Studies comparing two non-conventional positions will be reported and compared individually in relation to each other but will not be included in any sensitivity analysis.

Table 1	Inclusion and exclusion criteria
Population	Adult (≥18 years) patients and mannequin simulation exercises
Intervention	Non-conventional patient positions (head-down position, had-up position, etc)
Comparator	Supine patient position
Outcome	Patient-centred outcomes (desaturation episodes/hypoxaemia events, hypoxia, lowest oxygen saturation, aspiration events, duration of mechanical ventilation, ventilator-free days, ICU-free days, overall mortality, etc) and outcomes associated with difficult airway management (laryngoscopic view, time required to intubate, successful first-pass intubation, aspiration volume, etc)

ICU, intensive care unit.

Types of outcome

Our primary outcomes of interest are patient safety outcomes which include hypoxaemia, desaturation, aspiration, length of mechanical ventilation, ventilator-free days, ICU-free days and hospital mortality. Our secondary outcomes of interest aim to examine procedural outcomes such as the glottic view, time to intubate, successful first-pass intubation and aspiration volume.

Given that we cannot assess our primary patient safety outcomes in mannequin studies, we will only assess for secondary outcomes in these studies. In human studies, both primary and secondary outcomes will be evaluated.

Search strategy

We will conduct an initial search of MEDLINE with the assistance of our institute's trained clinical librarian in order to locate appropriate keywords in study titles and abstracts. We will then use these keywords to perform a comprehensive search of the following databases: MEDLINE, EMBASE and Cochrane Library (online supplemental file 1). We will then upload the title and their corresponding abstracts sourced from this search into Covidence (the online systematic review system).

Study selection

Two independent reviewers will examine the title and abstract for each study against the inclusion/exclusion criteria in Covidence. We will then consider studies with concordant approval for full-text review. A third independent reviewer, not involved in the initial screening, will review studies with discordant reviews to decide whether a study will be considered for full text review. We will then appraise the full text studies to determine if they are eligible for inclusion in the review. Covidence will generate a PRISMA flow diagram, which will display the number of studies initially screened, reviewed and excluded after full text review with their accompanying reasons(s).

Data extraction

Two independent reviewers will conduct data extraction using Covidence's data extraction tool. We will flag missing or discordant data for review, which will be resolved by a third independent reviewer. We will extract the following information from each study:

i. Study characteristics—Study type, country, date of publication, patient/mannequin study, setting (critical care, ED, operating room, etc), specialty of physician performing intubation (physician anaesthesiologist, emergency room doctor, medical learner, etc), materials used in intubation, funding sources.
ii. Population characteristics
    a. For studies involving patients: age, sex, body mass index (BMI), pre-existing morbidity (obstructive sleep apnoea, acute respiratory distress syndrome, etc), indications for intubation, years of clinical experience of participating physician(s), overall mortality.
    b. For studies involving mannequins: mannequin model, regurgitation trigger stimulated (yes/no), simulated difficult airway scenarios.
iii. Intervention characteristics—Positioning method of the patient/mannequin (Trendelenburg position, reverse Trendelenburg, etc) including the degree of incline in the ramped position and years of clinical experience of the participating physician. For studies involving human participants, age, sex, BMI and pre-existing morbidity will also be extracted.
iv. Comparator characteristics—Comparator(s) of interest include the supine position and years of clinical experience of the participating physician. For studies involving human participants, age, sex, BMI and pre-existing morbidity will also be extracted.
v. Outcomes—Outcomes of interest include the lowest oxygenation saturation (%), incidence of desaturation episodes (decrease in $SpO_2 > 3\%$), incidence of hypoxaemia ($SpO_2 < 90\%$) events, incidence of aspiration events, length of mechanical ventilation (days), ventilator-free days, ICU-free days and hospital mortality. Secondary outcomes centred around the process of intubation include Cormack-Lehane grade of view, time required for intubation, successful first-pass intubation and aspiration volume will also be extracted.

Methodological appraisal

We will assess each study selected for data-extraction for bias using validated tools specific for the type of study. We will use the Cochrane Risk of Bias tool to assess and report the risk of bias in randomised control trials across all domains (randomisation process, missing outcome data, etc). We will use the Newcastle-Ottawa Quality Assessment Scale to assess bias in case-control and prospective/retrospective cohort studies.

Data synthesis

We will examine full-text studies for the outcomes listed above. If possible, we will stratify outcomes into patient-centred/clinical outcomes and outcomes associated with difficult airway management (laryngoscopic grade of view, time required for intubation, successful first-pass intubation, etc). We will stratify all the studies involving human participants by the specialty of the physician conducting intubation. We also plan on reporting outcomes associated with difficult airway management stratified by the type of study (mannequin study vs patient study). We will report all quantitative continuous variables (eg, time to intubation) using mean/median values with an accompanying SD/CI and categorical variables (eg, incidence of aspiration) as a percentage in a table format. While we do not anticipate enough studies with similar methodology and outcomes, if we do encounter sufficient data, we will perform a meta-analysis using Review Manager V.5.3 provided by the Cochrane Collaboration (Oxford,

UK) and report heterogeneity using the I^2 statistic, where values >50% indicated moderate heterogeneity. A random effects model will be used when combined studies demonstrated at least moderate heterogeneity.

Sensitivity analysis

If the data are sufficient, we will perform sensitivity analyses on the specialty of the physician performing intubation and the material used during intubation to elucidate the effect of these characteristics on patient safety and procedural outcomes during RSI. In addition, with sufficient data, to ensure the consistency of results, we will perform a sensitivity analysis based on the type of study design (human or mannequin).

Patient and public involvement

Patients and or the public will not be directly involved in this systematic review, as all relevant metrics will be sourced from original published studies.

Ethics and dissemination

Ethics approval is not required, as this systematic review will use published data. The findings will be disseminated through publication in a suitable peer-reviewed journal and presentation at an appropriate conference.

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