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Systematic Review / Meta-analysis

Evidence-based airway management protocol for a critical ill patient in medical intensive care unit: Systematic review

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ABSTRACT

Background: Airway management outside the theatre is performed either to resuscitate a physiologically unstable critically ill patients or to secure an emergency airway in the absence of essential equipments. It is a life saving procedure for critically ill and injured patients. Delaying in securing airway or awaking the patient is not an option in case of difficult airway in intensive care unit. Therefore, developing and implementation of an evidence-based airway management protocol is important.

Objective: This review was conducted to develop a clear airway management protocol for a critical ill patient in medical intensive care unit.

Methods: After formulating the key questions, scope, and eligibility criteria for the evidences to be included, a comprehensive search strategy of electronic sources was conducted. The literatures were searched using advanced searching methods from data bases and websites to get evidences on airway management of a critical ill patient. Duplication of literatures was avoided by endnote. Screening of literatures was conducted based on the level of significance with proper appraisal. This review was carried out in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 statement.

Results: A total of 626 articles were identified from data bases and websites using an electronic search. Of these articles, 95 were removed for duplication and 305 studies were excluded after reviewing their titles and abstracts. At the screening stage, 79 articles were retrieved and evaluated for the eligibility. Finally, 40 studies related to airway management of a critical ill patient in medical ICU were included in this systematic review.

Conclusion: A critical ill patient needs oxygenation and ventilation support. A focused and rapid assessment, with special attention of the airway and hemodynamic status of the critical ill patient is paramount. An appropriate airway management option should be employed to resuscitate or to control an emergency airway of a critical ill patent. This could be non invasive ventilation or invasive airway intervention.

1. Introduction

Outside of the operating room, airway management is conducted to resuscitate a critically ill patient who is not physiologically stable or to secure an emergency airway in the absence of crucial equipment [1]. However, in the operating theater, endotracheal intubation (ETI) is performed generally in controlled conditions by anesthetist and has a low risk of complications [2]. Emergency intubation has been widely advised as a life-saving procedure for critically ill and injured patients as a result of real or potential compromises to the patient's airway and ventilation [3].

Critical care providers must be able to secure an airway via tracheal intubation for a variety of patients and clinical situations. When emergency intubation is required in the intensive care unit (ICU), this competency is typically tested by the critical ill patient's susceptibility to hypoxic injury. These patients usually have varying degrees of acute hypoxia, acidosis, and hemodynamic instability, and they tolerate delays in securing an airway poorly. The intubation attempt can aggravate other conditions such as intracranial hypertension, cardiac ischemia, upper airway hemorrhage, or vomiting [4].

A minimum of one out of every four major airway events (death, brain damage, rescue surgical airway, prolonged ICU stay) in a hospital

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is more likely to occur in the ICU, and the main cause of the events is a series of gaps in care, which include poor identification of at-risk patients, poor planning, inadequate equipment preparation to manage these events successfully, delayed recognition of events, and failed rescue due to a lack of or failure of Capnography interpretation [5].

Airway control in the ICU is more difficult than in the operating room. Critically ill patients have less physiological reserve, and the risk of endotracheal intubation-related complications is higher in the ICU than in the operating room. Adverse events might occur during anesthetic induction and after the patient has been intubated. Patients in the ICU with possible difficult airway should be identified early, and a strategy for managing the expected critical events should be planned. A difficult airway trolley should be provided immediately, and capnography monitoring should be employed for any airway intervention [6]. The aim of this review is to develop an evidence based protocol for airway management of a critical ill patient in a resource limited setting.

2. Rationale of the review

Airway management interventions are frequently performed outside the operating theatre, often during resuscitation of physiologically unstable patients or in an emergency to secure the airway. These situations occur unpredictably, frequently out of hours, and intubation is often performed with incomplete preparation and optimization of the critically ill patients.

Airway intervention out of the theatre is also performed without adequate preparation of routine and rescue airway equipments and a minimum standard monitoring that must be available or may not be immediately at hand in the emergency setting. As a result, the risks associated with out-of-theatre tracheal intubation are greater than those associated with intubation performed in operating theatre.

Similarly, in our medical ICU, air way management is performed without taking proper medical history and airway examination, resuscitating the critical ill patient, intubation check list of modified RSI and assistant which will make the adverse events of intubation worse and significant.

There are also some controversies in airway management protocols of a critical ill patient and the availability of a well-organized evidence-based protocol is limited. Therefore, developing an evidence-based working protocol for airway management of a critical ill patient in a resource limited intensive care unit is necessary.

3. Methods

3.1. Searching strategy

After formulating the key questions, scope, and eligibility criteria for the evidences to be included, a comprehensive search strategy of electronic sources was conducted. Terms like ‘airway management’, ‘ventilation’, ‘intubation’, ‘tracheostomy’, and ‘medical intensive care’ were keywords of the review question. Synonyms of the keywords were identified from national library of medicine via medical subject headings (MeSH) browser. Keywords were combined by a boolean operators “AND” or “OR” appropriately. We applied search terms in combination as: ‘airway management’ OR ventilation OR intubation OR tracheostomy AND ‘medical intensive care’.

The literatures were searched using advanced searching methods from data bases like cochrane library, Pub Med, scopus, embase and websites such as google scholar to get articles on airway management of a critical ill patient. The electronic literature search was performed from 15 April 2022 to 15 June 2022. All of the accessible studies that had been published in English language from inception up to 15 June 2022 were included in the present systematic review.

Duplication of literatures was removed by endnote. Further screening of literatures was conducted based on the level of significance by proper appraisal of the title, abstract and full text of the articles. A total of 40 articles were included and reviewed. The strength of evidence and grade of recommendation was made based on WHO 2011 level of evidence (**Table 1**). This review was reported in line with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 criteria ([41]) (Fig. 1). This review was registered in review registry with unique identifying number of 1372.

Table 1
Level of evidence and recommendations GCP, WHO, 2011.

Level of evidence	Type of evidence	Recommendation level
1a	Meta- analysis, systematic reviews of RCTs	strongly recommended/ directly applicable
1b	Systematic review of one RCT	Highly recommended/directly applicable
1c	Randomized clinical trials	Recommended/directly applicable
2a	Well organized case control or cohort study	Extrapolated evidence from other study
3a	Non analytic study e.g. case reports, case series	Extrapolated evidence from other study

3.2. Eligibility criteria

All studies that reported the airway management protocols for a critical ill patient, English language reporting, had full text available for search and took place across the globe were included in this systematic review. Those studies that reported duplicated sources, unrelated research, case reports, and articles with no full text available with attempts to contact the corresponding author via email were excluded in this systematic review.

3.3. Study selection

Three independent authors selected the candidate articles for the study, which were exported in to Endnote reference manager software to remove duplicates, and independently screened the titles and abstracts (BA, DY, and NS). Any disagreement was resolved through discussions lead by a third author.

3.4. Study quality assessment

The two independent authors appraised the standard of the study using AMSTAR 2 methodological quality appraisal checklist. Any disagreement was discussed and resolved by the authors. The critical analysis checklist has 16 parameters [42]. The quality of this review after critical appraisal of its method was reported as high.

4. Results

4.1. Study selection

A total of 626 articles were found from data bases and websites using an electronic search. Of these articles, 95 were removed for duplication and 305 studies were excluded after reviewing their titles and abstracts. At the screening stage, 79 articles were retrieved and evaluated for the eligibility. Finally, 40 studies related to airway management of a critical ill patient in medical ICU were included in this systematic review (Fig. 1).

4.2. Description of included studies

Out of 79 articles retrieved, 40 met the eligibility criteria and were included in the final systematic review. Out of all articles included, 16 were systematic reviews, 7 were systematic reviews and meta-analysis, 6 were randomized controlled trials, 4 were cross-sectional studies, 3 were

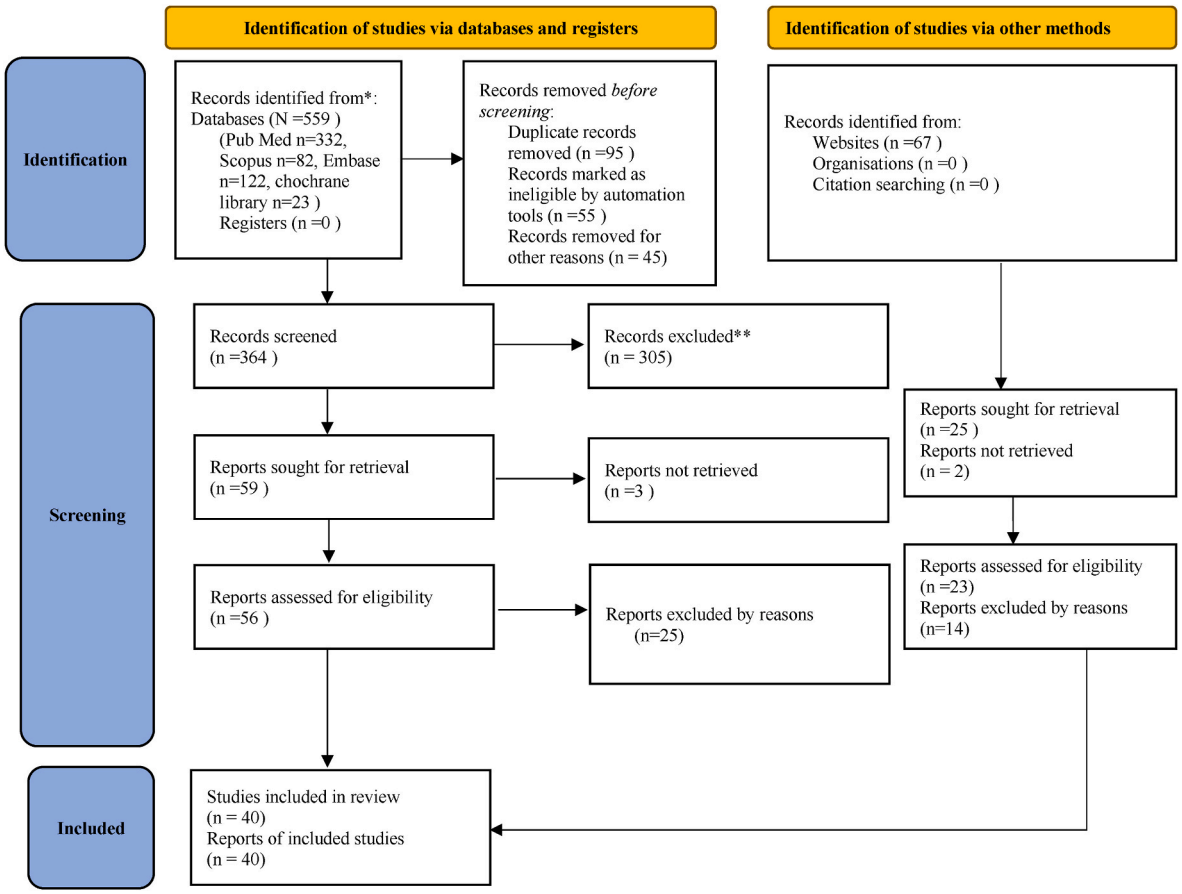

Fig. 1. Preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020.

guidelines, and 4 were cohort studies.

5. Discussion

This systematic review provides an evidence-based working protocol for airway management of a critical ill patient in a resource limited medical intensive care unit. This protocol guides clinicians to perform an appropriate airway intervention as early as possible.

Outside of the operating room, airway management is used to resuscitate severely ill patients who are physiologically unstable or to secure an emergency airway when necessary equipment is unavailable. For critically ill and injured individuals, it is a life-saving procedure. The oxygenation and ventilation of a critically ill patient is crucial. The airway and hemodynamic state of the critically ill patient must be assessed quickly and thoroughly. To resuscitate or control an emergency airway of a critically ill patient, an appropriate airway management approach should be utilized. Non-invasive ventilation or invasive airway intervention are two options.

Ventilatory support for a critical ill patient in intensive care unit (invasive or non-invasive) should be considered if respiratory rate >30/min, vital capacity <10–15ml/min, PaO2 <11kPa on FIO2 ≥0.4, PaCO2 high with significant respiratory acidosis (e.g. pH < 7.25), exhaustion, confusion, severe shock, severe LVF and raised ICP [8].

5.1. Airway assessment and optimization of a critical ill patient

Airway assessment should be done on the identification of patients at risk of difficult intubation and aspiration even in the most urgent situation. The only validated airway assessment method for a critical ill is the MACOCHA score. MACOCHA: Mallampati class III or IV, Apnea syndrome (obstruction), Cervical spine limitation, opening of mouth<3 cm, Coma, Hypoxemia, Anesthetist not trained and scores from 0 (easy) to 12 (very difficult). A 'MACOCHA' score of greater than or equal to 3 is a predictor of difficult intubation for a critical ill patient [7].

A Cochrane data base of systematic reviews of RCTs concludes that there is no evidence that resuscitation with colloids reduces death, compared with crystalloids in critically ill patients. In addition, the use of hydroxyl methyl starch might increase mortality and as colloids are expensive, it's hard to use in clinical practice to resuscitate a critically ill patients [23].

The Cochrane review of eight randomized trials concludes that the current available evidence is not suited to inform clinical practice and unable to determine the vasopressor of choice for the management of shock [24]. Cochrane data base systematic review of 28 RCTs to compare the effect of one vasopressor regimen (vasopressor alone, or in combination) versus another vasopressor regimen on mortality in critically ill patients with shock, findings suggest that major changes in clinical practice are not needed, but selection of vasopressors could be better individualized and could be based on clinical variables reflecting hypo perfusion [25].

Norepinephrine had superior benefit over dopamine for a critically ill patients with septic shock predominantly secondary to sepsis in the reduction of mortality [26]. Scandinavian clinical practice guideline on choice of first line vasopressor for patients with acute circulatory failure recommends norepinephrine rather than other vasopressors as first line choice of treatment for adult critically ill patients [27].

5.2. Choice of airway management strategy

A critical ill patient's airway interventions are determined by a number of circumstances. Airway, breathing, or hemodynamic condition, as well as the cooperation of a critically sick patient in the ICU all

influence which airway management method is used.

5.3. Non-invasive airway management

Non-invasive ventilation is applied in a critical care unit for patients with acute respiratory failure (ARF); like acute exacerbation of chronic obstructive pulmonary disease, hypoxemic respiratory failure and severe cardiogenic pulmonary edema. To be effective and for better outcome, NIV must be established early enough and should not delay intubation if required [9].

NIV indications: Hypoxemia requiring high respiratory rate, effort and FIO2,hypercapnia in a fatiguing patient, weaning modality, to avoid endotracheal intubation where desirable (e.g. severe chronic airflow limitation), increased work of breathing (e.g. asthma) and physiotherapy technique for improving FRC [8].

Non invasive positive pressure (NIPPV) initiation for hemodynamically stable patients with severe ALI had a high success rate. NPPV should be considered as a treatment option for patients in stable condition in the early phase of ALI/ARDS [10]. Early use of NIPPV decreases endotracheal intubation of ALI or ARDS but not mortality rate [11]. However, other studies concluded that non invasive ventilation decreases endotracheal intubation rates and mortality in acute hypoxemia non hyper capnic respiratory failure excluding chronic obstructive pulmonary disease exacerbation and cardiogenic pulmonary edema patients [21].

The addition of non invasive ventilation (NIV) as a standard care does not decrease endotracheal intubation rate or ICU survival. Thus, NIV, if tried should be under trial conditions and as early as possible in patients with ARDS not responding to standard medical therapy [12].

Comfort measures only, Do Not Intubate (DNI) orders, achieves good survival rate with an acceptable quality of life in a significant proportion of patients in contrast to claims by some experts that NIV in these patients merely prolongs the dying process. In addition, the provision of NIV in a well-equipped hospital ward may be a viable alternative to treatment in the ICU for selected patients [13].

5.4. Invasive airway management

Endotracheal intubation is considered if the patient develops: apnea (e.g. unconsciousness, severe respiratory muscle weakness, self-poisoning), respiratory failure (e.g. ARDS, pneumonia), airway protection (unconsciousness, trauma, aspiration risk, poisoning), airway obstruction (e.g. trauma, laryngeal edema, tumor, burns) and hemodynamic instability (e.g. shock, cardiac arrest) [8]. Tracheal intubation can be an acute airway emergency in itself. Unstable hemodynamic and failing oxygenation during emergency intubations can be life-threatening. Delaying securing airway or awaking the patient is not an option in case of difficulty in the ICU. Intubation failure or predicted difficulty should lead to alternatives such as NIPPV or tracheostomy [14].

Prolonged endotracheal intubation is the main indication of tracheostomy, performed after two weeks of intubation. Although there were no major early complications, tracheal stenosis is still a challenging sequel for tracheostomy that needs to be investigated to be prevented [15]. Tracheostomy is performed for not only the maintenance of the airway in the ICU and prevention of intubation-related complications, but also tracheostomy has recently been used for reducing the volume of dead space, decreasing airway resistance, and comforting patients during weaning from mechanical ventilation. Failure to wean from mechanical ventilator, patients needing long term mechanical ventilation because of neurological diseases and bronchial toileting for providing patent airway are some of the indications for tracheostomy in the ICU [16].

Percutaneous dilational tracheostomy (PDT) reduces the overall incidence of wound infection and may further reduce clinical relevant bleeding and mortality as compared with subcutaneous tracheostomy (ST) performed in the operating theatre. PDT, performed in the ICU, should be considered the procedure of choice for performing elective tracheostomy in critically ill patients [17].

Performing tracheostomy at an earlier stage for the critically ill adult patients who require prolonged mechanical ventilation than is currently practiced may shorten the duration of artificial ventilation and length of stay in the intensive care unit [18]. Patients with high risk of mortality and morbidity based on the presence of shock at onset of mechanical ventilation and high severity of illness scores and in whom no evidence of improvement can be shown during the first few days of mechanical ventilation, the option of early tracheostomy (within the first week from initiation of mechanical ventilation) should be discussed with the patient and/or family members [19].

Tracheal intubation in ICU is often life saving, however, life threatening events could happen in a significant proportion, making TI the most common but underappreciated airway emergency in ICU. The unstable physiologic state of critically ill patients along with inadequate evaluation of the airway and mild response to pre-oxygenation are the major factors for the high incidence of life-threatening hypoxemia and cardiovascular collapse in ICU. Therefore, implementation of an Intubation Bundle and a plan for difficult airway management is mandatory [14].

A review on standards of operating procedure (SOP) with a corresponding check list and rapid sequence induction (RSI) kit dump sheet will improve RSI planning, team dynamics and equipment availability. This standardized approach to RSI in ICU patients may reduce the occurrence of adverse events and improves patient outcome [40].

5.5. Pre-oxygenation of a critical ill patient

Pre-oxygenation before intubation with NIV and high flow nasal canulla (HFNC) has a beneficial role in success rate or safety of tracheal intubation in the critically ill [20]. High flow nasal canulla (HFNC) may be superior to comfort only measures in acute hypoxemic respiratory failure (AHRF) patients in terms of oxygenation, patient comfort, and work of breathing. It may be reasonable to consider HFNC as an intermediate level of oxygen therapy between COT and NIV [22].

A systematic review and meta analysis of randomized clinical trials and observational studies suggest that apneic oxygenation increases peri-intubation oxygen saturation and decreases hypoxemia and increases first pass intubation success rate [31]. Apneic oxygenation may significantly reduce the incidence of critical desaturation and significantly raises the minimum recorded SpO2 in ICU intubation and therefore, apnoeic oxygenation should be incorporated into ICU intubation protocol [32]. Adding HFNC for apnoeic oxygenation to NIV prior to orotracheal intubation is a novel strategy and may be more effective in reducing the severity of oxygen desaturation than the reference method using NIV alone [33]. However, in a randomized control trial of 150 medical ICU patients apneic oxygenation does not seem to increase lowest arterial oxygen saturation during endotracheal intubation of critically ill patients compared with usual care. These findings do not support routine use of apneic oxygenation during endotracheal intubation of critically ill adults [34].

A multi center RCTs on the effect of NIV on the reduction of subsequent organ failure concludes that there is no benefits of using NIV as preoxygenation compared with the usual preoxygenation method in hypoxemic critically ill patients requiring TI, but should not be discontinued until tracheal intubation is indicated [35].

5.6. Choice of induction agent and technique

In a randomized control trial “Ketofol” is associated with improved hemodynamic stability during the first 10 min after induction. This combination has the potential to be used as an alternative agent for critically ill patients when stable hemodynamics are desired [36]. However, In RCTs, Ketofol for emergency department (ED) procedural

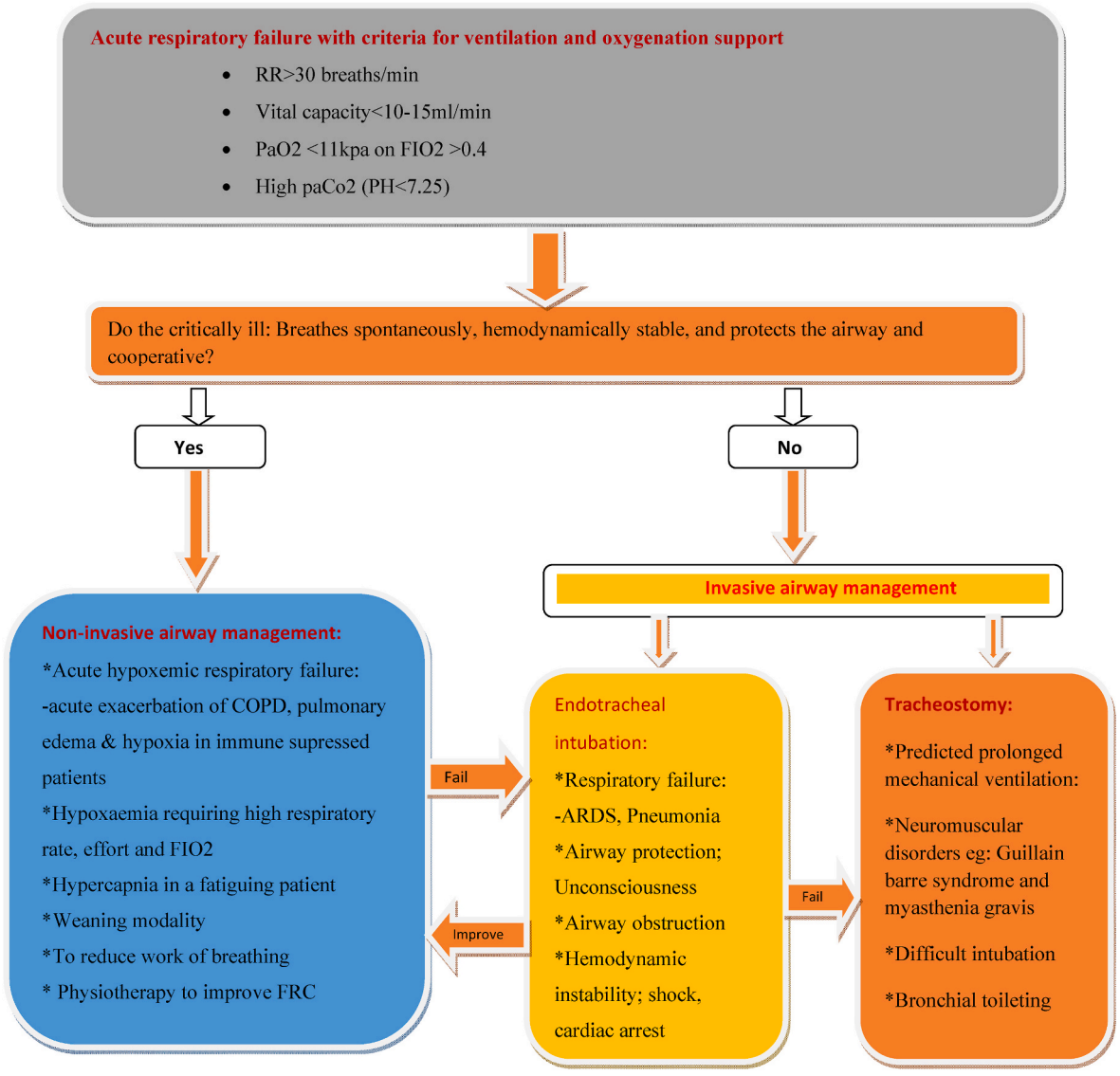

Fig. 2. Choice of airway management strategy in medical ICU.

sedation does not result in a reduced incidence of adverse respiratory events compared with propofol alone. Induction time, efficacy, and sedation time were similar; however, depth of sedation is more consistent with ketofol [37]. A Cochrane data base of systematic review of RCTs concludes that use of etomidate in critically ill patients, seems to increase the risk of adrenal gland dysfunction and multi-organ system dysfunction by a single dose. The clinical significance of this finding is unknown [38].

5.7. Choice of neuromuscular blocking agent

A randomized control trial In ICU patients undergoing RSI, incidence and severity of oxygen desaturation, the quality of intubation condition, and incidence of failed intubation attempts did not differ between succinylcholine and rocuronium [28]. However, a cochrane data base of systematic review of RCT concludes that Succinylcholine creates superior intubation conditions to rocuronium in achieving excellent and clinically acceptable intubating conditions for RSI [29].

5.8. Positioning and laryngoscopy

A multi center randomized clinical trials of ramped versus sniffing position during endotracheal intubation of 260 critically ill patients showed that ramped position didn't improve oxygenation during intubation of critically ill patients as compared with the usual sniffing position and even ramped position may worsen the glottic view and increases the number of laryngoscopy attempts for successful intubation [30].

A Cochrane data base systematic review of randomized control trials in adult patients undergoing laryngoscopy performed with a VLS or a Macintosh laryngoscope in a clinical, emergency or out-of-hospital setting concludes that Video laryngoscopes may reduce the number of failed intubations, particularly in a difficult airway. Currently, no evidence indicates that use of a VLS reduces the number of intubation attempts or incidence of hypoxia and no effects on the time required for intubation [39].

6. Areas of controversy

Air way management in ICU is a routine activity for critically ill patients but due to the absence of clear evidence based guide line there are controversies regarding the role of NIV, vasopressor of choice, apnoeic oxygenation, relaxants for RSI, type of laryngoscopy and TI itself.

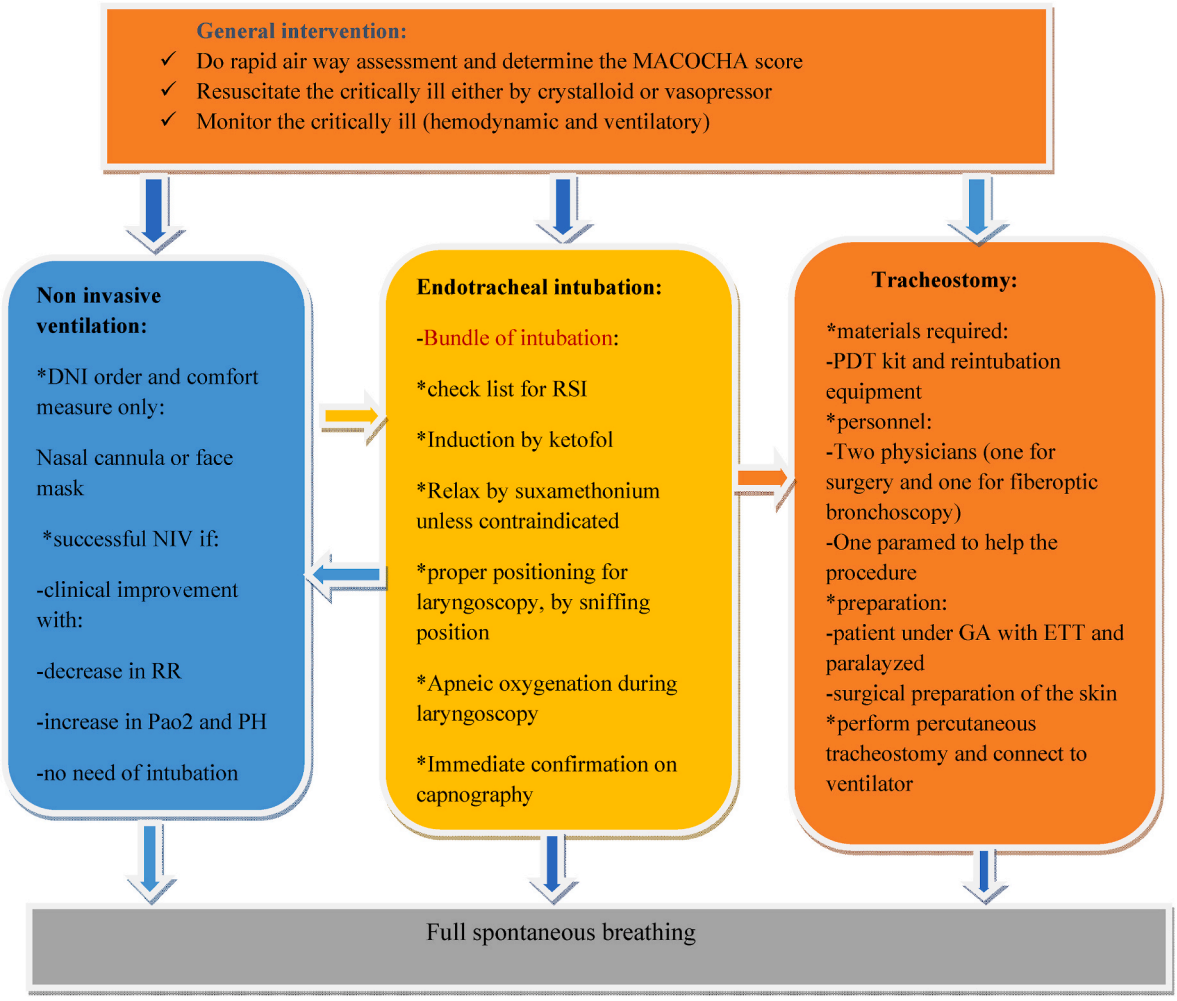

Fig. 3. *Airway management protocol in medical ICU.*

Tracheal intubation is a routine procedure in the intensive care unit (ICU), and is often life saving. However, life-threatening complications occur in a significant proportion, making endotracheal intubation perhaps one the most common but underappreciated airway emergencies in the ICU [14].

On the role of NIV a meta -analysis of six RCTs done by luo,jian concludes that early use of NIV decreases endotracheal intubation of ALI or ARDS but not mortality rate [11].On the other hand, a meta analysis of RCTs from 1980 to 2005 by Agarwal, Ritesh showed that the addition of NIV as a standard care for ARDS patients does not decrease endotracheal intubation rate or ICU survival [12].

On the choice of vasopressor, a Cochrane data base of systematic review of 28 RCTs in critically ill patients with shock, findings suggest that selection of vasopressors could be better individualized and could be based on clinical variables reflecting hypo perfusion [25].on the other hand a systematic review of six RCTs to evaluate randomized clinical trials with comparison of nor epinephrine versus dopamine in critically ill patients with septic shock predominantly secondary to sepsis showed a superior benefit of nor epinephrine over dopamine in mortality [26].

On apneic oxygenation, a systematic review and meta analysis of RCTs and observational studies from 2006 until July 2016 showed that apneic oxygenation increases peri intubation oxygen saturation and decreases hypoxemia and increases first pass intubation success rate [31]. On the other side apneic oxygenation doesn't seem to increase lowest arterial oxygen saturation during endotracheal intubation of critically ill patients compared with usual care and routine use of apneic oxygenation during endotracheal intubation of critically ill adults is not supported [34].

A randomized control trial on muscle relaxants for ICU patients undergoing RSI, incidence and severity of oxygen desaturation, the quality of intubation condition, and incidence of failed intubation attempts did not differ between succinylcholine and rocuronium [28]. On the other hand a Cochrane data base of systematic review of RCTs from 1988, February 14, 2015 concludes that Succinylcholine creates superior intubation conditions to rocuronium in achieving excellent and clinically acceptable intubating conditions for RSI [29].

A Cochrane data base systematic review of randomized control trials in adult patients undergoing laryngoscopy performed with a VLS or a Macintosh laryngoscope in a clinical, emergency or out-of-hospital setting concludes that Video laryngoscopes may reduce the number of failed intubations, particularly in a difficult airway. Currently, no evidence indicates that use of a VLS reduces the number of intubation attempts or incidence of hypoxia and no effects on the time required for intubation [31].

7. Conclusion and recommendations

Airway management in the ICU is commenced either to resuscitate a physiologically unstable patient or to secure the air way. This can be achieved by resuscitation, NIV or invasive airway intervention after a comprehensive assessment, with special attention of the airway and hemodynamic status of the critically ill patient (Fig. 2, Fig. 3 and Fig. 5).

Airway assessment should be done to identify patients at risk of

Factors:	points:
Factors related to patient	
▪ Mallampati class III or IV	5
▪ Obstructive sleep apnoea syndrome	2
▪ Reduced mobility of cervical spine	1
▪ Limited mouth opening<3cm	1
Factors related to pathology	
▪ Coma	1
▪ Severe hypoxemia(SPO2<80%)	1
Factors related to operator	
▪ Non anaesthetist	1
Total	12

***scores:**

0=easy

12=very difficult

Greater than or equal to 3 =predicted difficult intubation

Fig. 4. MACOCHA Score work sheet
MACOCHA: Mallampati class, apnea, cervical spine limitation, mouth opening, coma, hypoxemia, non anesthetist operator.

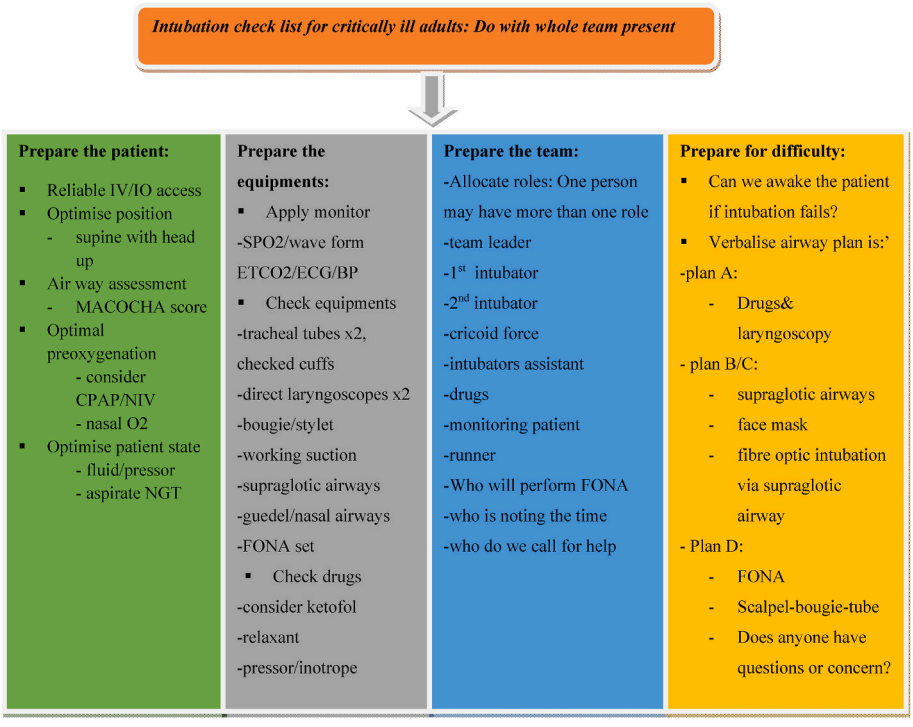

Fig. 5. Rapid sequence intubation kit preparedness
FONA: front of neck access, CPAP: continuous positive airway pressure, NIV: non invasive ventilation, ETCO2: end tidal carbon dioxide, BP: blood pressure, ECG: electrocardiography, SPO2: Spontaneous oxygen saturation.

difficult intubation and aspiration even in the most urgent situation. The only validated airway assessment in the critically ill patient is the MACOCHA score. A 'MACOCHA' score of greater than or equal to 3 is a predictor of difficult intubation (Fig. 4).

NIV is applied for most of the critically ill patients in ICU as a primary airway intervention and is effective in prevention of hypoxemia and cardiovascular collapse. Even though it reduces the need of endotracheal intubation rate, all equipments and the operator should be prepared for advanced intervention (Figs. 3 and 5).

Endotracheal intubation can be an acute airway emergency in itself. Delaying in securing airway or awaking the patient is not an option in case of difficulty in the ICU. Intubation failure or predicted difficulty should lead to alternatives such as NIPPV or tracheostomy. Therefore, developing and implementation of an intubation bundle is mandatory (Figs. 3 and 5).

Tracheostomy is performed at the bed side level in cases of anticipated difficult intubation, prolonged mechanical ventilation or for bronchial toileting of the critically ill patients in ICU and should be done after checking of PDT kit (Figs. 3 and 5).

8. Strength and limitation of the review

This review provides evidence-based working protocol for airway management of a critical ill patient in a resource limited intensive care unit. This protocol guides the physicians to do an appropriate airway intervention immediately and appropriately.

However, this review was conducted from different articles that are not homogenous in methods and study type. Moreover, this work emphasizes on the qualitative review of recommendations on airway management of a critical ill patient in ICU. Therefore, we recommend future researchers to conduct a meta-analysis of studies on airway management of a critical ill patient.

Ethical approval

The study was approved by the Ethical Committee of institution.

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Author contribution

Admass BA,Endale NS, Tawye HY, Melesse DY, Filatie TD and Workie MM developed key questions and keywords, analyzed the results of the search, prepared and revised the manuscript. All authors approved the final manuscript for publication.

Registration of research studies

Name of the registry: reviewregistry

Unique Identifying number or registration ID: reviewregistry1372.

Hyperlink to your specific registration (must be publicly accessible and will be checked): https://www.researchregistry.com/browse-the-registry#registryofsystematicreviewsmeta-analyses/.

Guarantor

Biruk Adie Admass, Nigussie Simeneh Endale, Hailu Yimer Tawye, Debas Yaregal Melesse, Tesera Dereje Filatie and Misganaw Mengie Workie are all responsible for this work.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Consent

Personal identifiers in the manuscript and during data collection processes were not included. So, consent for publication not applicable.

Declaration of competing interest

No conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.104284.

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