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Rapid Sequence Induction in Critically Ill Patients

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ABSTRACT

Healthcare providers face several challenges in the evaluation and management of critically ill patients. The complexity lies in knowing the placement of an advanced airway device, mainly in challenging airway scenarios. A rapid sequence induction plan related to pharmacological and non-pharmacological measures provides benefits and optimally avoids subsequent short- and long-term complications. This non-systematic review aims to perform an in-depth and analytical study of the different drugs, techniques, and practical measures in rapid sequence induction (RSI) to provide recommendations adapted to different types of patients in the hospital setting.

Keywords: Airway; Critical Care; Rapid Sequence Induction

Introduction

Rapid sequence induction (RSI) is defined as the administration of a hypnotic agent and a neuromuscular relaxant consecutively (virtually simultaneously), as well as other procedures to facilitate orotracheal intubation in the critically ill patient and reduce the risk of aspiration. RSI is indicated in the critically ill patient needing emergent airway isolation, with a high success rate for definitive orotracheal intubation. In addition, using RSI decreases stress levels and unsafe actions by the healthcare professional when performing the technique. RSI is frequently applied in the surgical environment, especially when the intervention is urgent and in emergencies in both in-hospital and out-of-hospital emergency departments. Therefore, the healthcare professional in these areas must master this sequence to achieve airway securing with the minimum risk of complications [1-3].

Rapid Sequence Induction Process

RSI consists of 7 steps:

1) Planification and preparation;

2) Pre-oxygenation;

3) Pre-treatment;

4) Sedation (induction) with neuromuscular paralysis;

5) Patient protection and positioning;

6) Checking the endotracheal tube or advanced airway device; and

7) Post-intubation management. These steps can be

modified according to the characteristics of the emergency and the peculiarities of each patient [3,4].

Step 1. Preparation

The person responsible for intubation should check that they have all the necessary equipment to carry it out in the best conditions: oxygen source, suction system, self-inflating bag, laryngoscope, endotracheal tubes, complex intubation equipment (laryngeal mask, cricothyrotomy equipment), resuscitation equipment, drugs, and patient monitoring (oxygen saturation, heart rate, blood pressure, and electrocardiographic recording). There is a «SOAPME» mnemonic rule to help remember all the equipment needed for intubation: Suction, Oxygen, Airway, Pharmacology, Monitoring, Equipment (solution, oxygen, airway, pharmacology, monitoring, and equipment) [3,4].

Evaluate the presence of difficult airways with the LEMON mnemonic:

- Look externally
- Evaluation 3-3-2
- Mallampati
- Obstruction of the airway
- Neck mobility

Look Externally

Short and directed examination of the jaw, mouth, neck, and internal airway. Anatomical features that could predict difficult ventilation [3,4].

- Obesity
- Abnormal facial shapes
- Facial or cervical trauma
- Large tongue

Evaluation 3-3-2

The use of 3-3-2 rule is employed, which consists of the following:

- Three fingers in the mouth (proper opening)
- Three fingers chin-floor of mouth (proper jaw)
- Two fingers from the floor of the mouth to the thyroid cartilage (adequate size and position of the neck)

Mallampati

It is a technique explored with the patient seated and upright. The patient is asked to open his mouth and stick out his tongue, and the hypopharynx is visualized using a light source. After observation, it is classified into four grades, predicting the difficulty of intubation in grades III and IV. In critically ill patients, in supine decubitus, and sometimes with a low level of consciousness, the hypopharynx is visualized by oral opening and manual extraction of the tongue by the person responsible for intubation, which is much more complex, calling into question the feasibility of this manoeuvre in the critically ill patient [3,4].

Obstruction of the Airway

The presence of upper airway infections (epiglottitis, peritonsillar and prevertebral abscesses), laryngeal masses or tumours, foreign bodies, extrinsic airway compression, and direct trauma, among others, is evaluated [3,4].

Neck Mobility

Proper mobilization and alignment of the head and mobilization of the cervical spine are assessed. Failure to have adequate mobility will result in a possibly difficult airway. It is essential to select the laryngoscope blade and the orotracheal tube appropriate to age and gender [3,4].

Step 2. Pre-oxygenation

Pre-oxygenation is performed simultaneously with the preparation. It consists of applying oxygen using a reservoir mask (FiO2 = 80 to 100%) for 5 min to replace the nitrogen of the functional residual capacity with oxygen (denitrogenation phenomenon), which allows a patient to be maintained for 3-8 min in apnea without hypoxemia. The desaturation time is directly related to weight: a healthy 70 kg patient will maintain oxygen saturation (SpO2) above 90% for 8 min, an obese 127 kg patient for 3 min, and a healthy 10 kg child for less than 4min. Some measures, such as elevating the head 25 ◦ during preoxygenation, can lengthen the desaturation time in patients with obesity, as well as the application in these patients of preoxygenation with continuous positive airway pressure (CPAP) at 7.5-10 cmH2O[3,4]. It is important to note that, at this time of RSI, manual ventilation with a mask and self-inflating bag should not be performed due to increased gastric pressure and the possibility of regurgitation or vomiting. However, if at any time during RDS the patient presents respiratory depression or later, after induction with paralysis, presents SpO2 below 90%, manual ventilation with positive pressure and high-flow oxygen is essential; the application of cricoid pressure or Zoellick's technique to prevent regurgitation is ineffective and at risk of causing tracheal injury, so it should be avoided [3,4].

Step 3. Pre-treatment

It consists of administering drugs before induction-relaxation to reduce the adverse side effects of orotracheal intubation (hypotension, bradycardia or tachycardia, increased intracranial pressure, and airway resistance) (Table 1). The application of

pre-treatment has benefits and risks adherent to the drug used. It is prefire to administer only drugs that have demonstrated the greatest benefit and to omit those without clear evidence, such as the previously non-depolarizing neuromuscular blocking agents. The drugs used in the pre-treatment of RDS are atropine, lidocaine, and short-acting opioids (fentanyl being the most commonly used). They are not always used as a general rule [3,4]. Pre-treatment, to be most effective, should be administered 3 min before starting induction. In cases of urgency that do not let intubation be delayed, it can be given with less time or be omitted [3,4].

Table 1: Premedication in RSI.

Medication	IV dose	Indications
Atropine	0,01-0,02 mg/kg	• Decreases the incidence of bradycardia to laryngoscopic stimulation
Lidocaine	1 mg/kg	• Decreases ICP and bronchospasm
Fentanyl	0,5 µg/kg	• Administer in all possible cases • Suspected elevated ICP • Ischemic heart disease • Aortic dissection

Note: ICP: intracranial pressure; RSI: rapid sequence induction [4].

Step 4. Sedation with Neuromuscular Palsy

Induction and simultaneous neuromuscular relaxation are performed to produce unconsciousness and muscle relaxation to facilitate orotracheal intubation and reduce the risk of aspiration (Tables 2 & 3). Currently, the most commonly used sedatives are etomidate, ketamine, propofol, and midazolam, although the latter is without indication for any specific clinical scenario; the choice of the optimal sedative will depend on each specific clinical situation we are faced with [5,6].

Table 2: Inductors in RSI.

Sedatives	IV dose (mg/kg)	Start (min)	BP	PIC
Etomidate	0,2-0,3	Less than 1	Minimum/increase	
Thiopental	3-5	Less than 1	Decrease	Decrease
Ketamine	1-2	One	Minimum/increase	Increase
Propofol	1-3	Less than 1	Decrease	Decrease
Fentanyl	1-2 µg	3-5	Decrease	Decrease
Midazolam	0,05-0,1	1-2	Minimum	Minimum

Note: IV: intravenous; ICP: intracranial pressure; RSI: rapid sequence induction; BP: blood pressure.

Table 3: Neuromuscular relaxants in RSI.

Muscle relaxants	IV dose (mg/kg)	Onset of effect (min)	Recovery (min)
Rocuronium	1-1,2	< 1	> 20
Succinylcholine	1-2	< 1	3-10

Note: RSI: rapid sequence induction.

Step 5. Patient Positioning and Laryngoscopy

In this phase, the patient is placed in the ideal position to facilitate intubation. Optimization of airway visualization is performed with the BURP manoeuvre. The ideal position for orotracheal intubation is the so-called «sniffing of the morning air» or «sipping English tea.» This position is achieved with the head hyperextended concerning the neck and the neck flexed concerning the trunk (except in the patient with suspected cervical spinal cord injury). This position is facilitated by slightly elevating the head of the bed or placing a small pillow on the occiput. This position achieves the ideal alignment of the three axes (oral, pharynx, and larynx) for optimal glottis visualization and facilitates orotracheal intubation. During direct laryngoscopy, a rapid assessment of the glottis visualization is performed. Here, it is determined whether

intubation can be difficult or not; it is evaluated with the Cormack-Lehane classification, where grade I-II predicts easy intubation and grade III-IV predicts difficult intubation [6,7].

Step 6. Check the Placement of the Endotracheal Tube

Verification of correct endotracheal tube placement is performed immediately after endotracheal intubation. Accidental intubation into the oesophagus or selective intubation into a bronchus can result in severe injury. There are several methods to verificate optimal endotracheal tube placement [8-10]:

- Direct visualization of endotracheal tube insertion through the vocal cords.
- Auscultation (at 5 points: both infraclavicular mid zones, bilateral axillary zone, axillary midline at the level of the fifth intercostal space and the epigastrium).
- Measurement of the introduced depth of the endotracheal tube through its markings at the level of the incisors.
- Capnography
- Chest X-ray
- Fibrobronchoscopy
- Ultrasound (pleural sliding)

Step 7. Post-Intubation Management

In this last phase, in addition to treating the underlying disease, adequate sedation, analgesia, and maintenance relaxation are administered when necessary, appropriate mechanical ventilation parameters are adjusted, monitoring is exhaustive (oxygen saturation, capnography, heart rate, blood pressure), and a chest X-ray is performed to diagnose the most frequent intubation complications rapidly. Precise adjustment of mechanical ventilation parameters should be performed to avoid ventilator-induced lung injury caused by a combination of volutrauma, atelectrauma, barotrauma, and biotrauma [10] (Table 4).

Table 4: Rapid Sequence Intubation Summary.

1. Preparation	· Telemetry, pulse oximetry, capnography · Material needed for intubation: laryngoscope, blades, orotracheal tubes, laryngeal mask, drugs, previous DA
2. Pre-oxygenation Perform in 3 min positive	· Administer FiO2 between 80 to 100%, avoiding the use of pressure
3. Pre-treatment	· Lidocaine 1 mg/kg in bronchospasm · Fentanyl 0.5 µg/kg for analgesia · Atropine 0.01-0.02 mg/kg if bradycardia or abundant secretions
4. Induction After 3 to 5 min after the start of premedication Paralysis Immediately after inducer	· Propofol 1-3 mg/kg · Ketamine 1,5 mg/kg · Etomidate 0.2-0.3 mg/kg · Fentanyl 1-2 µg/kg · Tiopental 3 to 5 mg/kg · Midazolam 0.05-0.1 mg/kg · Succinylcholine (depolarizing) 1-2 mg/kg · Rocuronium (non-depolarizing) 1.2 mg/kg
5. Patient positioning	· Axis alignment
6. Endotracheal tube check	· Pulmonary auscultation with adequate bilateral aeration · Capnography or capnometry · Ultrasound lung displacement · Tip of the orotracheal tube 2 cm above the carina on chest radiograph
7. Post-intubation management	· Monitor SpO2 > 90%, EtCO2 35-45 mmHg, perfusive BP

Note: $EtCO_2$: exhaled carbon dioxide; FiO_2: inspired oxygen fraction; BP: blood pressure; SpO_2: peripheral oxygen saturation; DA: difficult airway.

Macocha Scale

Currently, we have many predictive scales for difficult ventilation/intubation, such as Mallampati, intensivist distance, sternomental distance, sternothyroid distance, Bell House-Dore, mandibular protrusion, Langeron criteria for ventilation, and IPID scale, to know if it will be easy or if we will require assistance/manoeuvres/special equipment for intubation. The Macocha scale has a negative predictive value of 97% and a sensitivity of 76%. It integrates different variables, considering three collection groups: factors associated with the patient, factors associated with the disease per se, and factors related to the physician performing the intubation11, with a score ranging from 0 to 12.

The problem with this scale is that there is a grey area in between since the score of 0 is simple intubation, and 12 is very difficult intubation, with the intermediate scores undetermined, basing the highest score on the Mallampati scale. Consequently, the clinician's evaluation will always be the most important for decision making, given that there are difficult airways not foreseen with a higher percentage in emergency scenarios (Table 5).

Table 5: Macocha scale.

Variables	Score
Patient-related factors	
Mallampati III-IV	5
Obstructive sleep apnea	2
Decreased neck mobility	1
Oral opening less than 3 cm	1
Disease-related factors	
Coma	1
Respiratory insufficiency	1
Operator-related factors	
Non-anesthesiologist	1
Total	12
Scoring: 0 points: easy intubation; 12 points: difficult intubation.	

Discussion

Techniques used during RSI are those in which the patient can ventilate independently, achieving adequate oxygenation for intubation without requiring manual ventilation and techniques to prevent bronchoaspiration [11,12]. The Sellick manoeuvre is described as a temporary occlusion of the upper oesophagus by the pressure of the cricoid cartilage ring to prevent stomach contents from reaching the pharynx, thus preventing regurgitation [13,14]. The Sellick manoeuvre must be differentiated from the BURP manoeuvre, which arises due to the inability to visualize the glottis adequately and its adjacent structures (Back, Up, Right, and Pressure). This manoeuvre facilitates intubation and is even described as a 2-handed manoeuvre 2 [15-18].

Clinical Scenarios

In the different critical scenarios, teamwork is essential to offer more significant benefits to the patient and reduce the risk of comorbidities. It is essential to remember the pharmacology of the drugs involved in RDS since they should facilitate intubation in the shortest possible time, offering an adequate sedation-anaesthetic plane to the patient and effective analgesia but without affecting the hemodynamic status; they are classified into inducers, analgesics, and neuromuscular plaque blockers [19,20].

Inducers

Etomidate: The induction agent of choice in the unstable patient is its mechanism of action by increasing GABA's inhibitory effect. Its action is rapid 30-60 s, and its duration is 3-5 min, with a dose of 0.3-0.5 mg/kg. Side effects: inhibition of 11ß-hydroxylase important in adrenal steroid secretion [21].

Ketamine

The inducing agent that acts on NMDA receptors by antagonizing their active metabolites is called norketamine. It is ideal for asthmatics as it creates bronchodilation in unstable patients with aminergic reserve. Dose: 1-4 mg/kg IV, with an onset of action of 20-60 s and a duration of 15-20 min. Side effects: tachycardia due to noradrenaline reuptake, increased myocardial oxygen consumption, sympathetic stimulation increasing arterial pressure and heart rate, pulmonary arterial pressure, systemic vascular resistance, sialorrhea, dissociative states, and hallucinations [21].

Propofol

Lipid emulsion inducing agent 1% (soybean oil 10%, glycerol 2.25%, and phosphatide 1.2%) acts by GABA inhibition. Dose in patients of 1-2 mg/kg IV (in unstable patients, it is not highly recommended, but doses of 1 mg/kg IV can be used). The onset of action is 20-60 s, lasting 8 min. It is helpful for cerebral protection; it decreases myocardial and cerebral oxygen consumption, decreases mean arterial pressure by 20%, decreases intraocular pressure, and has an antiemetic effect. Side effects: rash, bradycardia, arterial hypotension, decreased systemic vascular resistance (SVR) and pulmonary vascular resistance, pain at the site of application, contraindication in preload-dependent cardiac patients, and SVR [22].

Diazepam

Long-acting benzodiazepines act by inhibiting GABA-A. It is rarely used in the context of RDS; however, in the cardiac surgery patient, it is widely used for induction, being a useful and safe alternative at doses of 0.2-0.4 mg/kg IV, with an onset of action of 60-90 s. Its duration is extended with a plasma peak of 30-90 min, and its active metabolite N-desmethyldiazepam can last in its elimination life of 20-70 h. Side effects: ataxia, euphoria, somnolence, rash, diarrhoea, fatigue, respiratory depression, urinary retention, hypotension, depression, incontinence, blurred vision, dysarthria [22]. Soleimani et al. conducted a prospective study comparing diazepam, propofol, and etomidate in the induction of patients with left ventricular failure and LVEF of less than 40% who were to undergo cardiac surgery, concluding that diazepam is the most favourable in maintaining hemodynamic status compared to propofol and etomidate [22].

Thiopental

This drug is a barbiturate used as an inducer. It acts at the NAD level, altering the respiratory chain and inhibiting GABA-A and AMPA receptors. Inducer dose of 3-5 mg/kg IV with the onset of action in 15-30 s; recovery time is 10 min after induction. It decreases metabolic oxygen consumption at the cerebral level and is used as a neuroprotector. However, its effects on hemodynamic stability are very marked, so the risk-benefit of this versus other drugs such as propofol would have to be assessed. Side effects: decreases cardiac output by 25%, decreases systemic vascular resistance, negative inotropic, reflex tachycardia due to hypotension, refractory hypotension, bronchoconstriction, decreases the effect of catecholamines, ADH, and corticosteroids, hyperglycemia, and can produce attacks of porphyria by increasing the production of the heme group [23].

Midazolam

This drug is used as an inductor in RDS at doses of 0.05-0.3 mg/kg IV, but it is not of choice in any scenario, only in the absence of the other inducers mentioned. Its onset of action is 20-40 s, lasting 8 to 15 min. It is not superior to the other inducers and does not show improvement in any clinical context, so its abandonment in RDS is becoming increasingly frequent. Side effects: nausea, vomiting, cough, delirium, euphoria, residual apnea, paradoxical reactions [21].

Neuromuscular Plate Blockers

Succinylcholine: Succinylcholine remains the gold standard in RSI. It is a neuromuscular blocker (NMB) of the depolarizing type due to its similarity to acetylcholine (ACH), presenting a high affinity for nicotinic receptors.

Its effective dose is 0.25 mg/kg, requiring 4 SD for ISR: 1 mg/kg, acting at a maximum of 60 s with an ultra-short duration of action of 8 min. Side effects: hyperkalemia (a single dose increases 0.5 mEq/l), tachyfilaxia, tachycardia due to stimulation of nicotinic receptors, fasciculations, muscle pain, increased intraocular pressure, and intragastric pressure if the patient does not present with hydro-electrolytic disorders, tachycardia, glaucoma. This drug is the one considered the drug of choice [23,24]. In 2018, the master of neuroanesthesia, James E. Cotrell, conducted a study published in the ASA journal about succinylcholine's effect on intracranial pressure. Administering boluses of 1-1.5 mg/kg in cats monitoring ICP, they observed an increase in normal conditions of 8 mmHg ICP up to 16 mmHg and in induced ICP increases of up to 10-20 mmHg, concluding that succinylcholine is associated with increased mortality when used for RSI in patients with brain damage, due to alterations in brain dynamics [25].

Rocuronium

This drug is a non-depolarizing type of BNM, preventing ACH from binding to them and activating them. Its DE is 0.3 mg/kg, requiring 4 DE for ISR: 1.2 mg/kg to obtain complete relaxation in a maximum of 60 s and duration at 4 DE of up to 120 min26. Side effects: idiosyncratic blood pressure disturbances (1.2%), dose-dependent tachycardia, histamine release, pruritus, malignant hyperthermia, residual neuromuscular blockade [23,24].

Opioids

Fentanyl: This drug is the opioid of choice for laryngoscopy, inhibits vagal reflexes, and produces dose-dependent analgesia at doses of 0.5-3 μg/kg, causing minimal hemodynamic instability, with a time of action of 3.6 min to reach the effector site (ES) and a duration of 30-50 min [23,24]. Side effects: nausea, emesis, pruritus, urinary retention, constipation, apnea, and bradycardia. It is the most studied agent in RDS and is considered the ideal analgesic opioid for this dose-dependent scenarios [26].

The combination of these drugs lets the airway be approached faster and safer; the KETASED study was performed in critically

ill patients using ketamine versus etomidate as an inducer. Both maintained hemodynamic stability of the patient; however, the use of etomidate was associated with a period of relative adrenal insufficiency [27]. Jabre et al. compared two groups of drugs: etomidate and fentanyl versus ketamine and midazolam, with 20 patients per group, finding that etomidate and fentanyl obtain good results in terms of hemodynamic maintenance, being superior to midazolam as an inducer, and ketamine is an excellent alternative in the septic patient [28]. Soleimani, et al., in a study comparing the inducers diazepam, propofol, and etomidate in patients with heart disease with decreased left ventricular ejection fraction (LVEF), concluded that diazepam showed better hemodynamic stability than the other inducing agents [22]. Cotrell has published the increase in intracranial pressure with succinylcholine [25], with rocuronium at four effective doses in RDS being the agent of choice in these cases. Kramer, et al. in 2018 mentioned that lidocaine could be associated with hypotension events during induction in the neurocritical patient [29]. However, a study by Staikou et al. using the bispectral index showed that adding lidocaine to induction did not show that it affected anaesthetic depth or hemodynamic changes [30]. Pharmacological suggestions are proposed according to the patient's clinical scenario: hemodynamic instability, neurocritical, cardiopathic, and bronchospasm (Tables 6-9). In the end, an algorithm is established to help with decision-making when faced with a patient who merits airway invasion (Figure 1).

Table 6: RSI Suggestions in the hemodynamically unstable patient.

Pre-treatment
· Fentanyl: 0.5 to 1 µg/kg IV (essential to provide adequate analgesia to the patient and avoid vagal reflection offered by laryngoscopy, and
· Lidocaine: 1 mg/kg IV has demonstrated benefits in the cardiac patient and the context of the patient's hemodynamically compromised
Induction
· Etomidate: 0.2 mg/kg (avoid in the septic patient), or
· Ketamine: 1.5 mg/kg (avoid in the cardiac patient or those without aminergic reserve)
Neuromuscular relaxant
· Succinylcholine: 1 mg/kg (avoid in hyperkalemia, burn or glaucoma, or neurocritical patients)

Note: RSI: rapid sequence induction.

Table 7: RSI suggestions in neurocritical patient.

Pre-treatment
• Fentanyl: 0.5 to 1 µg/kg IV, and
• Lidocaine: 1 mg/kg IV; in neurotrauma, its benefit does not seem entire.
Induction
• Propofol: 1-2 mg/kg IV, decreases cerebral oxygen consumption. MAP must be monitored during induction so as not to compromise CPP, or
• Thiopental: 3-5 mg/kg IV, decreases cerebral oxygen consumption, ideal for neuroprotection; patient's hemodynamic status must be monitored so as not to compromise CPP, or
• Etomidate: 0.3 mg/kg
Neuromuscular relaxant
• Rocuronium: 1 mg/kg

Note: MAP: mean arterial pressure; CPP: cerebral perfusion pressure; RSI: rapid sequence induction.

Table 8: RSI suggestions in patients with heart disease.

Pre-treatment
• Fentanyl: 0.5 to 1 µg/kg IV (essential to provide adequate analgesia to the patient and avoid vagal reflection offered by laryngoscopy), and
• Lidocaine: 1 mg/kg IV has demonstrated benefits in the cardiac patient and the context of the hemodynamically compromised patient
Induction
• Etomidate: 0.2 mg/kg, or
• Diazepam: 0.2-0.4 mg/kg (ideal in the cardiopathic patient), or
• Propofol: 1 mg/kg (can be used while monitoring the hemodynamic context to avoid compromise of coronary perfusion pressure)
Neuromuscular relaxant
• Succinylcholine: 1 mg/kg, or
• Rocuronium: 1 mg/kg (in case succinylcholine is not available or contraindicated)

Note: RSI: rapid sequence induction.

Table 9: RSI recommendations in patients with bronchospasm.

Pre-treatment
• Fentanyl: 0.5 to 1 µg/kg IV, and
• Lidocaine: 1 mg/kg IV, beneficient for a patient with bronchospasm
Induction
• Ketamine: 2-4 mg/kg IV (agent of choice in a patient with bronchospasm), or
• Etomidate: 0.2 mg/kg (avoid in a patient with coexisting sepsis)
Neuromuscular relaxant
• Succinylcholine: 1 mg/kg, or
• Rocuronium: 1 mg/kg (in case succinylcholine is not available or contraindicated)

Note: RSI: rapid sequence induction.

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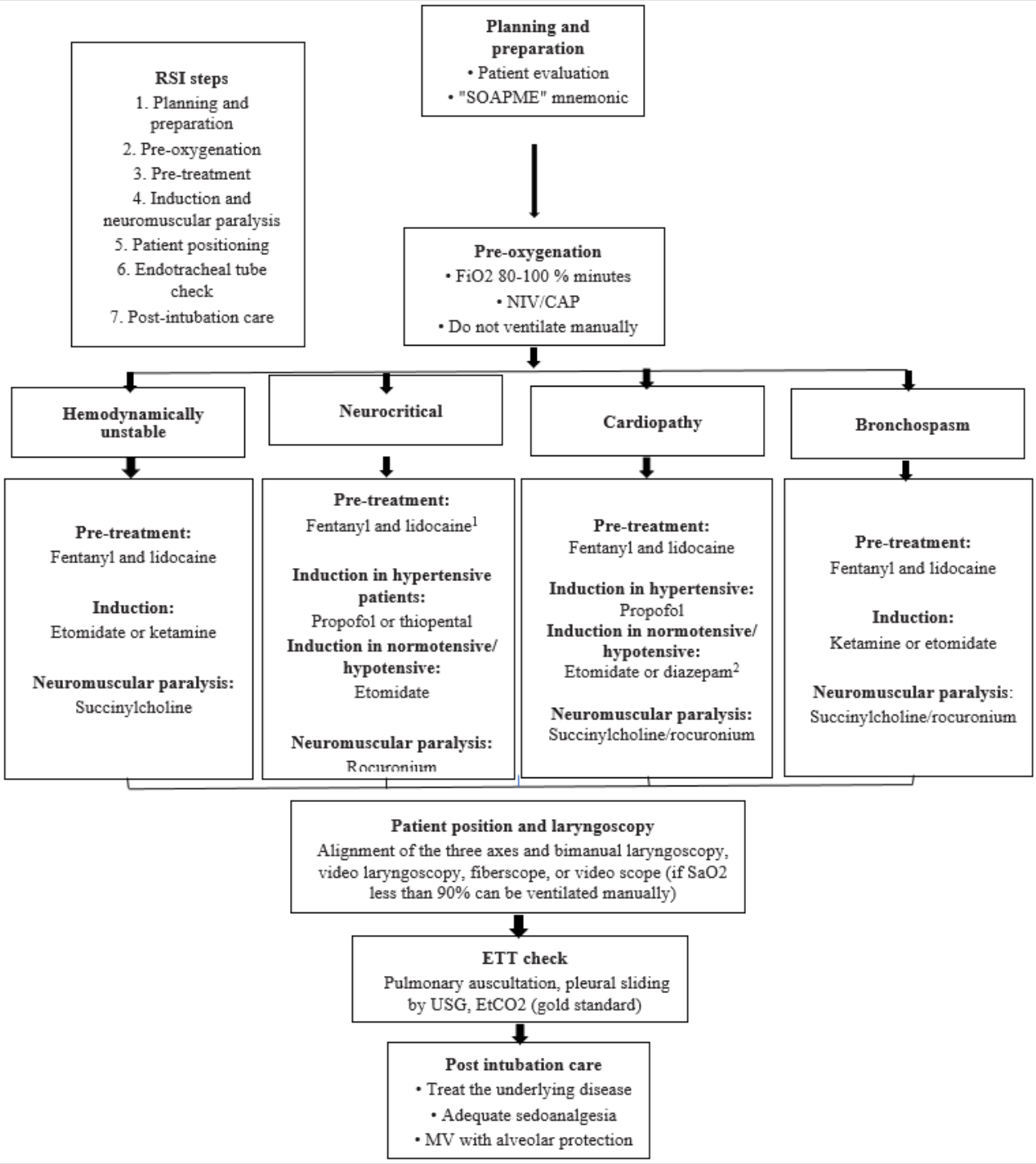

Note: CAP: continuous airway pressure; NMR: neuromuscular relaxation; RSI: rapid sequence induction; ETT: endotracheal tube; MV: mechanical ventilation; NIV: non-invasive mechanical ventilation.

Figure 1: Specific RSI scenarios

1. Lidocaine with no proven benefit in neurotrauma.
2. Diazepam at high doses of 0,2-0,4 mg/kg.

Conclusion

RSI is an action guide to invade the airway and provide ventilatory support either by pulmonary or extrapulmonary causes; it requires knowledge of the technique of orotracheal intubation, the pharmacology of the drugs used, as well as identifying the benefits and adverse effects of them. A rapid approach to the airway aims to minimize the risk of bronchoaspiration and protect oxygenation. The critically ill patient usually requires ventilatory support; clinical scenarios range from shock to respiratory failure, and knowledge of the pros and cons of each drug used in RSI steps is imperative.

Highlights

What is already known regarding this topic?

I. The patient must be pre-oxygenated with 100% oxygen during induction to maximize their functional residual capacity. It is recommended to administer oxygen for 3 to 5 minutes or until the expired oxygen fraction is at least 85%.

II. The effectiveness of cricoid pressure in preventing regurgitation varies according to the study.

III. Cricoid pressure application may fail to disrupt laryngoscopy, laryngeal distortion, occlusion of the oesophagus, and, less frequently, oesophagus rupture during active vomiting.

What does this research add?

I. RSI requires knowledge of the technique of orotracheal intubation, the pharmacology of the drugs used, and the ability to identify their benefits and adverse effects.

II. Pre-oxygenation is performed simultaneously with the preparation. It consists of applying oxygen using a reservoir mask (FiO2 = 80 to 100%) for 5 min to replace the nitrogen of the functional residual capacity with oxygen (denitrogenation phenomenon), which allows a patient to be maintained for 3-8 min in apnea without hypoxemia.

III. The application of cricoid pressure or Zoellick's technique to prevent regurgitation is ineffective, and at risk of causing tracheal injury, so it should be avoided.

References

1. Li J, Murphy-Lavoie H, Bugas C, Martinez J, Preston C (1999) Complications of emergency intubation with and without paralysis. Am J Emerg Med 17(2): 141-143.
2. Sivilotti ML, Filbin MR, Murray HE, Slasor P, Walls RM (2003) Does the sedative agent facilitate emergency rapid sequence intubation? Acad Emerg Med 10(6): 612-620.
3. Tayal VS, Riggs RW, Marx JA, Tomaszewski CA, Schneider RE (1999) Rapid-sequence intubation at an emergency medicine residency: success rate and adverse events during a two-year period. Acad Emerg Med6(1): 31-37.
4. Stollings JL, Diedrich DA, Oyen LJ, Brown DR (2014) Rapid-sequence intubation: a review of the process and considerations when choosing medications. Ann Pharmacother 48(1): 62-76.
5. Kallstrom TJ, American Association for Respiratory Care (AARC) (2002) AARC Clinical Practice Guideline: oxygen therapy for adults in the acute care facility--2002 revision & update. Respir Care 47(6): 717-720.
6. Smally AJ, Nowicki TA, Simelton BH (2011) Procedural sedation and analgesia in the emergency department. Curr Opin Crit Care 17(4): 317-322.
7. Soltani Mohammadi S, Saliminia A, Nejatifard N, Azma R (2016) Usefulness of Ultrasound View of Larynx in Pre-Anesthetic Airway Assessment: A Comparison With Cormack-Lehane Classification During Direct Laryngoscopy. Anesth Pain Med 6(6): e39566.
8. Fein DG, Zhao D, Swartz K, Nauka P, Andrea L, et al. (2021) The Impact of Nighttime on First Pass Success During the Emergent Endotracheal Intubation of Critically Ill Patients. J Intensive Care Med 36(12):1498-1506.
9. DuCanto J, Serrano KD, Thompson RJ (2017) Novel Airway Training Tool that Simulates Vomiting: Suction-Assisted Laryngoscopy Assisted Decontamination (SALAD) System. West J Emerg Med 18(1): 117-120.
10. Denton G, Green L, Palmera M, Jones A, Quinton S, et al. (2022) Advanced airway management and drug-assisted intubation skills in an advanced critical care practitioner team. Br J Nurs 31(11): 564-570.
11. De Jong A, Jung B, Jaber S (2014) Intubation in the ICU: we could improve our practice. Crit Care 18(2): 209.
12. Rochwerg B, Brochard L, Elliott MW, Hess D, Hill NS, et al. (2017) Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure. Eur Respir J 50(2): 1602426.
13. Sellick BA (1961) Cricoid pressure to control regurgitation of stomach contents during induction of anaesthesia. Lancet 2(7199): 404-406.
14. Salem MR, Khorasani A, Zeidan A, Crystal GJ (2017) Cricoid Pressure Controversies: Narrative Review. Anesthesiology 126(4): 738-752.
15. Knill RL (1993) Difficult laryngoscopy made easy with a "BURP". Can J Anaesth 40(3): 279-282.
16. Snider DD, Clarke D, Finucane BT (2005) The "BURP" maneuver worsens the glottic view when applied in combination with cricoid pressure. Can J Anaesth 52(1): 100-104.
17. Yentis SM (1997) The effects of single-handed and bimanual cricoid pressure on the view at laryngoscopy. Anaesthesia 52(4): 332-335.
18. Thiagarajah S, Lear E, Keh M (1990) Anesthetic implications of Zenker's diverticulum. Anesth Analg 70(1): 109-111.
19. Matioc AA (2019) An Anesthesiologist's Perspective on the History of Basic Airway Management: The "Modern" Era, 1960 to Present. Anesthesiology 130(5): 686-711.
20. Taboada M, Doldan P, Calvo A, Almeida X, Ferreiroa E, et al. (2018) Comparison of Tracheal Intubation Conditions in Operating Room and Intensive Care Unit: A Prospective, Observational Study. Anesthesiology 129(2): 321-328.
21. Chaiyakulsil C, Chantra M, Katanyuwong P, Khositseth A, Anantasit N (2018) Comparison of three non-invasive hemodynamic monitoring methods in critically ill children. PLoS One 13(6): e0199203.
22. Soleimani A, Heidari N, Habibi MR, Kiabi FH, Khademloo M, et al. (2017) Comparing Hemodynamic Responses to Diazepam, Propofol and Etomidate During Anesthesia Induction in Patients with Left Ventricular Dysfunction Undergoing Coronary Artery Bypass Graft Surgery: a Double-blind, Randomized Clinical Trial. Med Arch 71(3): 198-203.
23. Stewart JC, Bhananker S, Ramaiah R (2014) Rapid-sequence intubation and cricoid pressure. Int J Crit Illn Inj Sci 4(1): 42-49.

24. Sparr HJ, Beaufort TM, Fuchs-Buder T (2001) Newer neuromuscular blocking agents: how do they compare with established agents? Drugs 61(7): 919-942.

25. Cottrell JE (2018) Succinylcholine and Intracranial Pressure. Anesthesiology 129(6): 1159-1162.

26. Quintard H, l'Her E, Pottecher J, Adnet F, Constantin JM, et al. (2019) Experts' guidelines of intubation and extubation of the ICU patient of French Society of Anaesthesia and Intensive Care Medicine (SFAR) and French-speaking Intensive Care Society (SRLF): In collaboration with the pediatric Association of French-speaking Anaesthetists and Intensivists (ADARPEF), French-speaking Group of Intensive Care and Paediatric emergencies (GFRUP) and Intensive Care physiotherapy society (SKR). Ann Intensive Care 9(1): 13.

27. Freund Y, Jabre P, Mourad J, Lapostolle F, Reuter PG, et al. (2014) Relative adrenal insufficiency in critically ill patient after rapid sequence intubation: KETASED ancillary study. J Crit Care 29(3): 386-389.

28. Jabre P, Combes X, Lapostolle F, Dhaouadi M, Ricard-Hibon A, et al. (2009) Etomidate versus ketamine for rapid sequence intubation in acutely ill patients: a multicentre randomised controlled trial. Lancet 374(9686): 293-300.

29. Kramer N, Lebowitz D, Walsh M, Ganti L (2018) Rapid Sequence Intubation in Traumatic Brain-injured Adults. Cureus 10(4): e2530.

30. Staikou C, Paraskeva A, Karmaniolou I, Vezakis A, Tsaroucha A (2013) Intravenous lidocaine does not affect the anesthetic depth during rapid sequence induction and intubation as assessed by Bispectral Index monitoring: a randomized double blind study. Arch Med Sci 9(4): 713-718.

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