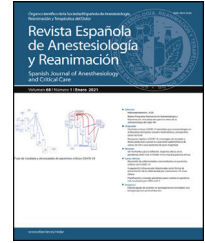




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CONSENSUS STATEMENT

Spanish Society of Anesthesiology, Reanimation and Pain Therapy (SEDAR), Spanish Society of Emergency and Emergency Medicine (SEMES) and Spanish Society of Otolaryngology, Head and Neck Surgery (SEORL-CCC) Guideline for difficult airway management. Part II



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Tracheostomy;
Airway obstruction;
Monitoring

Abstract The Airway Management section of the Spanish Society of Anesthesiology, Resuscitation, and Pain Therapy (SEDAR), the Spanish Society of Emergency Medicine (SEMES), and the Spanish Society of Otorhinolaryngology and Head and Neck Surgery (SEORL-CCC) present the Guide for the comprehensive management of difficult airway in adult patients. Its principles are focused on the human factors, cognitive processes for decision-making in critical situations, and optimization in the progression of strategies application to preserve adequate alveolar oxygenation in order to enhance safety and the quality of care. The document provides evidence-based recommendations, theoretical-educational tools, and implementation tools, mainly cognitive aids, applicable to airway management in the fields of anesthesiology, critical care, emergencies, and prehospital medicine. For this purpose, an extensive literature search was conducted following PRISMA-R guidelines and was analyzed using the GRADE methodology. Recommendations were formulated according to the GRADE methodology. Recommendations for sections with low-quality evidence were based on expert opinion through consensus reached via a Delphi questionnaire.

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PALABRAS CLAVE

Manejo de la vía
aérea;
Guía clínica;
Sedación consciente;
Anestesia general;
Intubación
endotraqueal;
Mascarilla laríngea;
Traqueostomía;
Obstrucción de la vía
aérea;
Monitorización

Guía de la Sociedad Española de Anestesiología, Reanimación y Terapéutica del Dolor (SEDAR), Sociedad Española de Medicina de Urgencias y Emergencias (SEMES) y Sociedad Española de Otorrinolaringología y Cirugía de Cabeza y Cuello (SEORL-CCC) para el manejo de la vía aérea difícil. Parte II

Resumen La sección de Vía Aérea de la Sociedad Española de Anestesiología, Reanimación y Terapéutica del Dolor (SEDAR), la Sociedad Española de Medicina de Urgencias y Emergencias (SEMES) y la Sociedad Española de Otorrinolaringología y Cirugía de Cabeza y Cuello (SEORL-CCC) presentan la Guía para el manejo integral de la vía aérea difícil en el paciente adulto. Sus principios están focalizados en el factor humano, los procesos cognitivos para la toma de decisiones en situaciones críticas y la optimización en la progresión de la aplicación de estrategias para preservar una adecuada oxigenación alveolar con el objeto de mejorar la seguridad y la calidad asistencial. El documento proporciona recomendaciones basadas en la evidencia científica actual, herramientas teórico-educativas y de implementación, fundamentalmente ayudas cognitivas, aplicables al tratamiento de la vía aérea (VA) en el campo de la anestesiología, cuidados críticos, urgencias y medicina prehospitalaria. Para ello, se realizó una amplia búsqueda bibliográfica según las directrices PRISMA-R y se analizó utilizando esta metodología. Las recomendaciones se formularon de acuerdo con esta metodología. Las recomendaciones de aquellas secciones con evidencia de baja calidad se basaron en la opinión de expertos mediante el consenso alcanzado a través de un cuestionario Delphi.

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Known or anticipated difficult airway

Awake airway management is the technique of choice in patients with known or anticipated difficult airway (EO 85.7%)¹ since it (1) preserves airway patency and spontaneous ventilation, increases respiratory reserve, and protects against aspiration by preserving laryngeal reflexes^{1,2}; (2) facilitates a gradual transition to positive pressure ventilation (PPV) and slow induction of general anaesthesia (GA) in patients at risk of haemodynamic collapse^{3,4}; (3) facilitates tracheal intubation by preventing soft tissue collapse, dilating peritracheal structures, improving the glottic view by preventing the larynx from adopting a more anterior position, and allowing the operator to locate a distorted glottis by the presence of air bubbles; (4) can be performed in a sitting position in a collaborative patient, which also helps evaluate the patient's neurological status; (5) keeps all treatment options open and allows for decision-making based on findings.^{1,3,5–8}

A known or anticipated DA requires formulation of team strategies with a comprehensive multidisciplinary discussion beforehand about sequential plans (primary and alternative) to achieve oxygenation and ventilation and prevent aspiration.^{1,7,9,10}

When the DA is secondary to an obstructive pathology, the team will need to evaluate the patient's respiratory status and the cause, location, and degree of obstruction (greater or less than 50%) using clinical signs and symptoms, imaging tests, and flexible nasolaryngoscopy (FNL).^{1,7,10,11} The risks and benefits of each approach must be carefully considered and the strategy must be agreed by the entire medical-surgical team.¹ Fig. 1 shows a cognitive aid for decision-making in the event of an anticipated DA. Lower-tier plans act as rescue strategies in the event of failure of the upper-tier plan if selected as primary. In all cases, it is advisable to perform awake airway management. (1) Supraglottic lesions causing mild obstruction that can be overcome with an ETT allow for TI, usually fiberoptic intubation (FOI). (2) In the case of obstructive supraglottic lesions causing stenosis greater than 50% (or with inspiratory stridor at rest),⁷ non-obstructive supraglottic lesions that impede TI (or would cause unacceptable morbidity), and glottic or subglottic lesions, it is advisable to perform tracheotomy or cricothyrotomy as a primary approach.¹⁰ (3) Lower tracheal obstructive lesions not salvageable with an ETT or tracheal cannula require the application of extracorporeal membrane oxygenation (ECMO).¹⁰

Active oxygenation strategies should be implemented throughout the procedure. High-flow nasal oxygen therapy (HFNO), although requiring further validation in this context, may be the technique of choice. HFNO is recommended over conventional low-flow cannulas (EO 91.4%).

Awake tracheal intubation

When the airway can be secured noninvasively, awake tracheal intubation (ATI) remains the gold standard technique^{3,12,13} due to its safety and reliability.^{14,15} The cornerstones of successful ATI are: continuous oxygenation, topicalization of the airway, sedation (optional), and selection, experience, and use of an appropriate TI device and

technique. The ideal protocol in terms of efficacy and safety is unknown, so the most appropriate one should be chosen based on the clinical context and the individual characteristics of each patient, as well as the experience and preferences of the operator.^{16–18} Fig. 2 shows the SEDAR SEMES SEORL-CCC cognitive aid for TI of the anticipated DA.

Oxygenation

Continuous oxygenation improves safety by preventing or minimizing hypoxaemia.^{12,19} Conventional methods may be insufficient to avoid desaturation.²⁰ HFNO increases tolerance of an airway obstruction, hypoventilation, and longer apnoea time,^{20–23} and despite the scant evidence, it is becoming the method of choice.^{13,24}

NIV through an endoscopy face mask could be useful when intubating critically ill patients with severe hypoxaemia (EO: 82.9%).²⁵

Topicalization

Applying topical anaesthesia to the airway is a key step in successful ATI.¹ Lidocaine (2%–4%), which has a favourable cardiovascular and systemic toxicity risk profile, is the most widely used local anaesthetic.^{12,19,26–28} The maximum dose should not exceed 9 mg/kg,^{13,29} and only the minimum necessary dose should be used.

The “spray as you go” (SAYGO) technique with an epidural catheter or an atomizer, and regional nerve blocks (glossopharyngeal, superior laryngeal, or transtracheal injection) are the most employed methods for topicalization of the respiratory mucosa.^{2,12,27} These techniques are often used in combination.²⁸ There is no evidence of the superiority of any particular technique,¹⁶ although nerve blocks are more invasive, require multiple bilateral injections, demand experience, and are associated with a higher incidence of complications.^{2,13,16} Transtracheal injection (4 ml of 4% lidocaine) is perhaps the most useful invasive method as it: (1) anaesthetises the infraglottic larynx, upper trachea, and even the supraglottic structures³⁰; (2) has a success rate of over 95%¹²; and (3) is seldom associated with complications (1:10,000), although they can be important.^{28,31}

The SAYGO technique can minimize the risk of aspiration, because laryngeal reflexes are maintained until just before inserting the ETT.² Premedication with an antisialogogue is recommended to maximise the local anaesthetic effect and improve the field of vision (EO 80%). The antisialogogue of choice is glycopyrrolate (3 µg/kg), because it is fast-acting, has no effect on the central nervous system, and has a mild vagolytic action.^{2,12,32} When administered 15–20 min before reduces the dilution and esophageal elimination of the local anesthetic by secretions.¹

Regardless of the method used, topicalization should include the oral cavity, nasal cavity if nasotracheal intubation is planned, oropharynx, periglottic area, larynx and trachea.^{1,30} Otherwise, the insertion of the device and the ETT can provoke reflex responses from the airway, such as coughing or laryngospasm, as well as a cardiovascular response mediated by the sympathetic nervous system.³³

Sedation

Sedation is an optional complement to adequate topical anaesthesia in ATI¹⁶ (EO 88.6%), as awake tracheal intuba-



Anticipated difficult airway

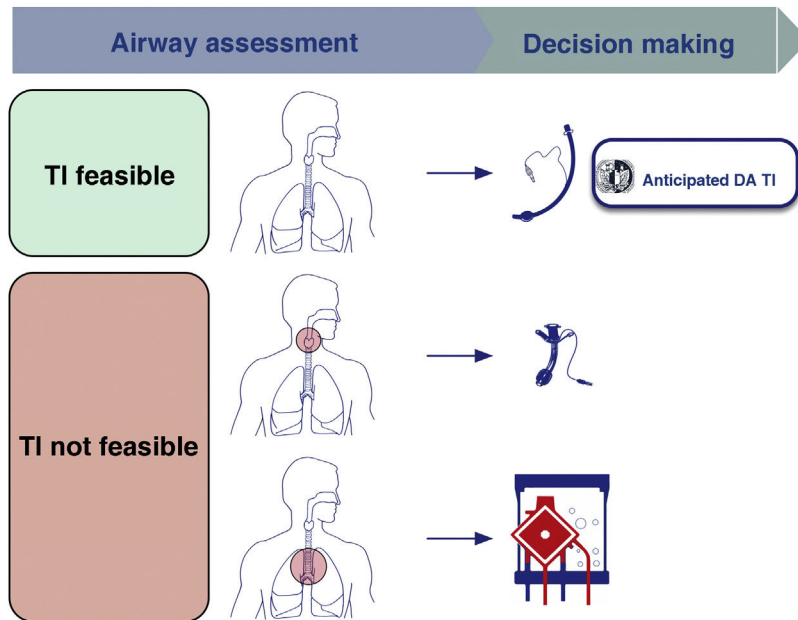


Fig. 1 Cognitive aid to facilitate decision-making in the anticipated difficult airway. DA: difficult airway; TI: tracheal intubation.

tion with prior psychological preparation can be performed safely and effectively without sedation.^{19,28,34} It should never compensate for inadequate topicalization. Although very high levels of anxiety can increase the physiological response to stress and reduce tolerance, oversedation can cause loss of cooperation, respiratory depression, hypoxia, hypercapnia, airway obstruction, aspiration, and cardiovascular instability,^{19,35,36} so sedation should only be administered after a detailed risk-benefit analysis. The goals of sedation are (EO 94.3%)^{1,19,35}: (1) effective anxiolysis and amnesia while maintaining patient cooperation (“conscious sedation”, sedation level 2–3 on the Ramsay scale)^{28,37}; (2) analgesia to suppress the cough and gag reflexes and reduce the haemodynamic response while preserving airway patency, spontaneous ventilation, and avoiding aspiration. Sedation must be carefully monitored to avoid oversedation, so ideally a second operator should be exclusively responsible for its administration and monitoring.^{13,19}

All sedation regimens used have shown a satisfactory level of efficacy and safety¹⁶; however, dexmedetomidine, with its anxiolytic, sedative, analgesic, and sympatholytic action, may be the safest and most effective option because it is less likely to cause apnoea and desaturation, is well tolerated, and is associated with better intubation conditions and less recall compared to other drugs^{16,38–40}; however, it can produce episodes of severe bradycardia and hypotension.³⁵ Its ability to maintain respiratory function integrity, even with deep levels of sedation, makes it a good choice for patients at risk of airway obstruction and/or respiratory failure.³⁵ Opioids, particularly remifentanyl, attenuate the cough and gag reflexes, although they may increase the risk of chest rigidity and laryngospasm.^{6,13,19} They are also associated with a high incidence of recall

when used alone, and are therefore usually combined with a benzodiazepine such as midazolam.^{19,28} Monotherapy is usually more predictable and reliable, although the availability of specific opioid and benzodiazepine antagonists improves their safety profile. Remifentanyl is a good option when topical anaesthesia has been ruled out.^{35,41} Propofol is associated with a low incidence of recall, although it can increase the risk of over sedation, airway obstruction, and coughing.^{13,35,42} Table 1 shows the main drugs used for sedation.

Tracheal intubation device

FOI is classically considered the method of choice for ATI,^{2,17,37,43} due to its versatility and unique ability to combine with other devices in any treatment plan,⁴⁴ as well as its efficacy and safety.^{16,45} However, FOI has a steep learning curve and skills must be maintained with regular practice; it is also fallible and not available in all settings.^{37,46}

VL-guided ATI may be faster than FOI – a factor that could reduce the risk of aspiration – and the skills are easier to learn and maintain.^{46,47} It has a similar success rate and safety profile as FOI, and equally high patient and operator satisfaction rates,^{17,43,47,48} making it a valid alternative for a first-line technique.^{13,17,46–49} Videolaryngoscopes with a hyperangulated blade, with or without a guide channel, are indicated for ATI. In certain circumstances, VL offers additional advantages over FOI.^{17,37,43} It can accommodate an ETT of any diameter³⁷ and allows the operator to change the ETT without removing the videolaryngoscope,⁴⁷ and unlike FOI, which is performed blind, it allows the operator to observe the passage of the ETT through the vocal cords, thus reducing the risk of ETT impingement and the resulting trauma.^{37,50,51} However, unlike FOI, VL-guided ATI is not fea-



Anticipated difficult airway

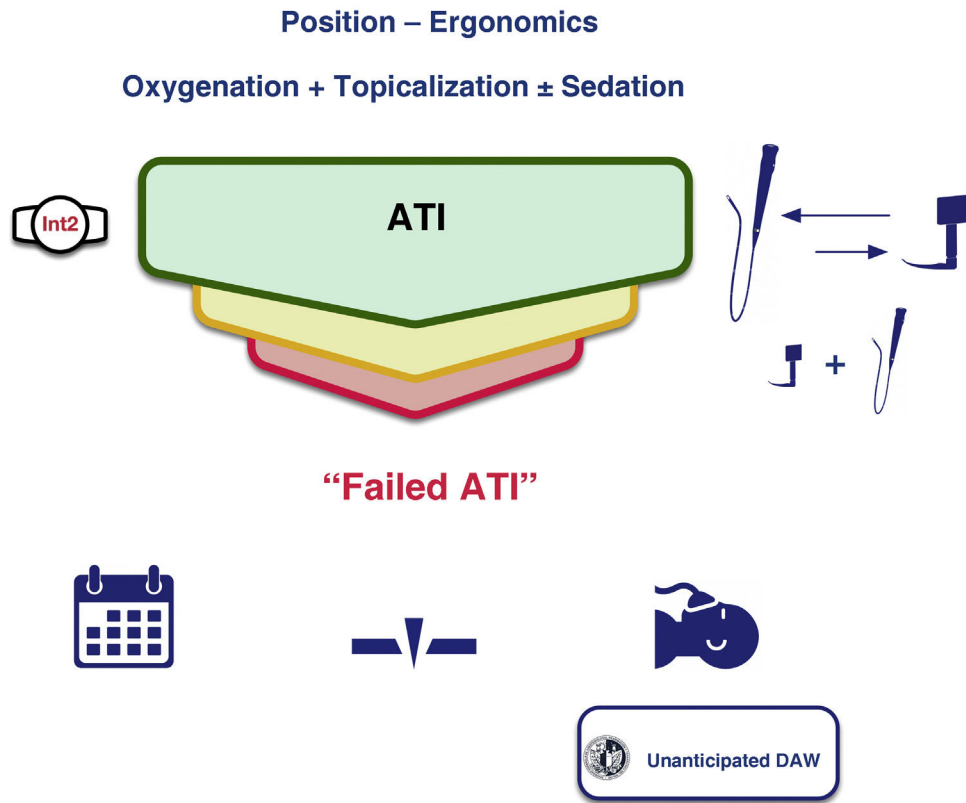


Fig. 2 Cognitive aid for tracheal intubation of an anticipated difficult airway. ATI: awake tracheal intubation; DA: difficult airway; Int2: second operator.

sible in patients with a mouth opening of less than 18–20 mm or a space-occupying lesion in the oral cavity,³⁷ and in patients with cervical spine instability without manual stabilization it may cause greater cervical spine movement,⁵² although the outcomes appear to be similar.^{53,54} VL, therefore, cannot completely replace FOI.^{37,43}

There is insufficient evidence to recommend any particular technique, so the choice should be context-oriented.^{43,48} Both approaches are equivalent and complementary⁴³; a failed attempt with one can be rescued with the other, and they can be used in combination - mainly in highly complex cases.^{2,17,37}

Single-use flexible FBs are as safe as reusable scopes,^{55,56} although there is evidence to suggest that they minimise the risk of cross-contamination infection and are more resource-saving and cost-efficient.^{57,58}

Procedure

Conditions of the 4 components of ATI must be optimal from the first attempt in order to maximize the likelihood of success and minimize the number of attempts. If the first-line technique (FOI or VL) fails, the alternative technique should be used (EO 80%). A third attempt may benefit from a multimodal approach, namely VL + FOI (EO 100%), which

combines the advantages of both devices.⁵⁹ This combination can improve the first attempt success rate, reduce TI time, TI-related morbidity,^{60,61} and could be the approach of choice in patients with severely distorted airways.

The combination of an intubating SGA and FOI can be a useful rescue technique to maintain oxygenation and airway patency and be used as a conduit to facilitate TI (EO 100%). SGA acts as a conduit for FOI, and protects the periglottic structures from secretions or blood.^{62–64} It also facilitates the localization of the glottis and reduces the difficulty of railroading the ETT over the FB,⁵¹ while the FB aids correct SGA placement. This technique can be further simplified by using the latest video laryngeal masks.^{65,66}

No more than 3 attempts at TI should be made (EO 88.6%), because repeated attempts increase the risk of oedema, laryngeal bleeding, and total airway obstruction.⁵¹ This is particularly important in the case of preexisting airway obstruction, which can rapidly progress to a CICO situation.^{9,67} Each failed attempt should be followed by an evaluation of each component of ATI to determine if optimization is feasible.

Factors such as surgical access, anatomical characteristics, extubation plan, and operator preference determine the choice of TI technique.⁶⁸

Table 1 Main drugs used for sedation during awake tracheal intubation.

Drug	Dose	Effects	Advantages	Disadvantages
Dexmedetomidine	0.7–1.0 µg/kg bolus for 10 min, followed by infusion of 0.5–1.0 µg/kg/hour	Sedation/analgesia/amnesia/antisialogue	Safe respiratory profile	Bradycardia, hypotension
Remifentanyl	Infusion of 0.03–0.1 µg/kg/min; Bolus of 0.05–0.1 µg/kg	Analgesia/antitussive	Suppresses cough reflex	Respiratory depression Abolishes laryngeal reflexes Recall
Midazolam	Boluses of 0.015–0.03 mg/kg	Amnesia/sedation	Combined with opioids Amnesia Minimizes side effects	Respiratory depression
Fentanyl	Bolus of 0.7–1.5 µg/kg	Analgesia/antitussive	Fast onset	Respiratory depression Abolishes laryngeal reflexes
Propofol	Infusion of 25–75 µg/kg/min; Bolus of 25–75 µg/kg	Sedation	Amnesia Synergistic effect with other drugs (reduction in required doses)	Over-sedation Airway obstruction Episodes of hypoxaemia Does not suppress cough reflex
Ketamine	Boluses of 0.07–0.15 mg/kg	Sedation/analgesia	Preserves muscle tone and protective airway reflexes Opioid-sparing effect Concomitant use with dexmedetomidine increases haemodynamic stability	Agitation (avoided by coadministration with midazolam), inadequate level of sedation, severe cough, and unpleasant recall Increased secretions (requires premedication with an antisialogue) Myocardial depression in catecholamine depletion

Doses extracted from Gil K, et al.⁶

The main cause of TI failure^{19,51} and glottic or subglottic injury^{50,69} is difficulty railroading the ETT over the FB, stylet or exchanger and through the vocal cords due to impingement on periglottic structures, mainly the right arytenoid cartilage.^{2,50} Silicone ETTs with a Murphy eye, such as the LMA Fastrach™ ETT (Teleflex Medical, Dublin, Ireland),⁷⁰ those with a central orifice and backward-facing bevel such as the Parker Flex-Tip™ ETT (Parker Medical, Highlands Ranch, CO 80126, USA),^{71–74} LMA Fastrach™ ETT⁷⁵ and BlockBuster ETT (Tuoren Medical Instrument co, Ltd, Changyuan city, China),⁶⁹ and those made of flexible material with or without a slight anterior curvature, such as the LMA Fastrach™ wire-reinforced ETT^{69,76} reduce the incidence of this complication.^{50,69,72,76,77} The Parker Flex-Tip ETT is recommended over conventional ETTs for FOI in the general population (1B). Inserting the tube with the bevel facing backwards, or rotating the tube 90° counter-clockwise after insertion facilitates advancement.^{78–80} Other useful manoeuvres are neck flexion and releasing mandibular traction or cricoid pressure.^{51,80} There should be less difference between the external diameter of the FB and the internal diameter of the ETT in order to facilitate FOI (EO 85.7%),^{2,51,81} or an intubation catheter (e.g., Aintree catheter [AIC; Cook Critical Care, Bloomington, IN, USA]) can be used between the fiberscope and the

ETT. Similarly, using the specific ETT for each device will facilitate VL-guided TI.⁸² The Parker Flex-Tip ETT should be considered instead of conventional ETTs to reduce the risk of FOI- and laryngoscopy-related complications in the general population (1C).

Narrow-bore ETTs give better laryngeal vision during laryngoscopy and facilitate TI by reducing the risk of impingement on periglottic structures.^{51,83,84} Large-bore ETTs are associated with greater morbidity.^{83,85–90} ETTs with up to 6.0 mm internal diameter allow the passage of intubation devices, suction devices, and narrow-bore FBs. PPV can be performed without increasing the risk of ventilator-induced lung injury or air trapping,^{91,92} even when high minute volumes (Vm) are required. The use of narrow-bore ETTs does not increase the risk of injury from aspiration or high cuff pressure, and might even provide a better seal than large bore ETTs.⁹³ Narrow-bore ETTs may not be safe in all cases, such as in patients with abundant secretions or impaired airflow. Therefore, a smaller than usual ETT is recommended when performing FB and VL (EO 85.7%), provided a context-oriented risk-benefit analysis has been performed.^{83,84,90,94}

After TI has been confirmed visually (visualisation of passage of the ETT through the glottis on VL and identification of the carina and advancement of the ETT up 2 or 3 tracheal

rings above the carina on FB), GA should be induced after inflating the cuff and confirming TI with capnography (EO 94.3%).²

Fallback techniques and approaches should be planned in advance and implemented without delay after failure of the primary technique (EO 100%).^{12,67} If a failed ATI is declared, the team has 3 options (1) postpone the procedure, if feasible; (2) perform awake FONA or emergency FONA in the case of airway obstruction and loss of control of the airway; (3) induce GA with complete NMB and follow the algorithm for unanticipated DA. This is a high risk option. Deep sedation or GA induced with ketamine under spontaneous ventilation could be a more favorable step than establishing apnea⁹⁵ (Fig. 2).

A FONA plan must be prepared before attempting ATI if it is likely to fail and result in complete airway obstruction (EO 88.6%)⁹⁶ (the “double setup”, see below): the CTM should be marked on the neck to guide the incision,³ and the neck and FONA kit must be prepared with the surgical team present.⁹ Multidisciplinary management and coordination with an ENT specialist is essential.^{1,97}

Recommendation

The use of the Parker Flex-Tip ETT is recommended over conventional ETTs for FOI in the general population.

Strong recommendation; moderate level of evidence (⊕⊕⊕⊖)

The Parker Flex-Tip ETT is suggested instead of conventional ETTs for FOI and laryngoscopy to reduce the risk of complications in the general population.

Strong recommendation; low level of evidence (⊕⊕⊖⊖)

Awake alternative techniques

Front of neck access

Awake tracheostomy under local anaesthesia should be performed in patients with pre-existing critical airway compromise (EO 82.9%). If the upper airway is severely distorted or obstructed due to a tumour, haematoma, severe oedema, bilateral vocal cord paralysis, or haemorrhage, awake FONA under local anaesthesia could be the safest option to secure the airway as the primary plan^{67,98–102} because: (1) instrumentation of the upper airway can cause bleeding or oedema, can aggravate occlusion, and even cause distal tumour seeding^{7,9}; (2) topical anaesthesia may exacerbate a pre-existing occlusion^{1,103} or trigger laryngospasm^{1,9}; (3) FB can cause a “cork in a bottle” effect⁷ and complete airway collapse. Multidisciplinary DA teams work faster and have a higher first-attempt success rate.¹⁰⁴

The recommended technique is tracheostomy performed by a trained operator.¹⁰⁵ Sedation should be avoided if possible. HFNO appears to be effective in extending safe apnoea time,¹⁰⁶ although full precautions should be taken and no

electrical instruments should be used during the tracheal opening.¹⁰⁷ The procedure requires patient collaboration, since the supine position and neck extension are often poorly tolerated.¹⁰⁶ Anaesthesia can be induced once ventilation has been confirmed with capnography.¹⁰⁸ The full moon view of the tracheal lumen on FB confirms that the cannula is correctly positioned. A crescent moon image indicates the need to reposition or change the cannula.

Awake cricothyrotomy secures the airway more rapidly, and is therefore indicated in patients presenting critical airway compromise (EO 91.4%).¹⁰⁹

Extracorporeal membrane oxygenation

Awake ECMO under local anaesthesia may be the safest option when all 4 conventional plans are likely to be impossible, to fail, or to be ineffective and the patient is at risk of complete airway obstruction (EO 90.6%). Recent advances in technology have made it possible to include ECMO as a means of securing adequate gas exchange in these situations,^{110,111} particularly when difficulty is due to tracheobronchial disease or extrinsic compression that causes critical central airway obstruction or makes FONA unfeasible.^{67,110} In these cases, elective awake ECMO under local anaesthesia may be the safest option.^{67,112,113} Once the situation has been brought under control, the airway is secured to prevent aspiration. Table 2 shows the main indications for ECMO.

ECMO, however, is costly and can lead to complications,^{111,114–116} so the decision to use it must be taken by a multidisciplinary team.¹¹⁶ If the indication is uncertain, the ECMO system can be put on standby with the vessels cannulated and a perfusionist present before proceeding with airway management.¹¹⁶

Veno-venous ECMO is associated with fewer complications, does not require therapeutic levels of anticoagulation, requires only a single double-lumen cannula, and could therefore be the technique of choice in these situations.^{110,111} In haemodynamically unstable patients requiring cardiopulmonary support due to obstructive pathology such as a large mediastinal mass, veno-arterial ECMO or even a conventional extracorporeal circulation circuit may be needed.¹¹⁰

In extreme cases, such as massive haemoptysis or central foreign bodies, ECMO may be the last resort.^{64,117} Establishing ECMO, however, can be complicated and time-consuming, so it is currently not indicated to rescue a CICO situation after induction of GA, even though several authors have described its use in this context.

Unanticipated difficult airway

Periprocedure oxygenation

Discussed in the corresponding section

Airway management

TI is associated with more complications than other non-invasive plans, so it should be carefully weighed up and only performed when indicated.¹¹⁸

Table 2 Main indications for extracorporeal membrane oxygenation (ECMO).**Tracheobronchial pathology**

- Tracheobronchial tumours with critical stenosis
- Non-tumour-related tracheal stenosis (caused by prolonged intubations or tracheostomies, obstructive tracheal papillomatosis)
- Tracheal deformities
- Tracheal injury (accidental or iatrogenic)
- Haemoptysis (need for anticoagulation may complicate haemostasis)
- Pathologies that require complex surgery (bronchopleural fistulas, trachea-oesophageal fistulas, carinal resections)
- Tracheal stent-related complications
- Foreign bodies in the airway

Extrinsic pathology

- Thyroid tumours or large goitres with severe tracheal invasion or compression
- Mediastinal masses with severe compression of the airway and/or great vessels or chambers of the heart

The primary goal in airway management should be to minimize the number of attempts in order to avoid a CICO situation and the need for FONA. Planning and optimization are essential.¹¹⁹

Given the unreliability of predictors,^{120,121} planning should be geared towards a potentially DA.¹²² Decision-making should be “context-oriented” rather than focused on specific devices and techniques.^{8,123}

The first attempt must be made under optimal conditions (EO 100%) in order to maximize the likelihood of success (“make the first attempt the best attempt”).^{119,122,124–126} Additional attempts are only justified when there is room for improvement and a new approach will optimise the foregoing technique or substantially improve the probability of success (for example, changing the size or type of device, using a new adjunct, or changing the operator, as required).^{119,127}

FMV and the depth of anaesthesia and NMB should be verified between attempts. Adequate ventilation between attempts using a face mask or second-generation supra-glottic airway device (2GSGA) provides the opportunity to “stop and think”, reformulate the strategy, or bring in new resources while maintaining the initial principles. Fig. 3 shows the unanticipated DA management algorithm.

Failure of non-invasive plans necessitates declaring a CICO situation, ensuring adequate NMB, and immediately performing FONA regardless of SpO₂.

Tracheal intubation

Videolaryngoscopy. Failure of the first TI attempt implies a lower probability of success in subsequent attempts.^{60,119,128} Multiple attempts can lead to trauma, oesophageal intubation, hypoxaemia, cardiovascular events, a CICO situation, unplanned admission to a critical care unit, or death.^{129–134} Up to 93% of difficult TIs are unanticipated,¹²¹ so the most appropriate first-line technique should be the one that gives the greatest likelihood of achieving success on the first attempt (EO 94.3%).^{119,122,124–126}

Most meta-analyses, despite their heterogeneity,^{135,136} suggest the superiority of VL over direct laryngoscopy (DL) (Supplementary data 4). Overall, VL compared to DL increases first-attempt success,^{137–150} improves glottis

visualization,^{140,141,143,145–148,150–158} and reduces the incidence of complications - mainly trauma and oesophageal intubation -^{141,142,144–147,149,152,155–157,159–162} by up to 50%.¹⁵⁰

The outbreak of the COVID-19 pandemic,^{135,163–167} cost reduction,¹⁸ and the widespread availability of videolaryngoscopes coupled with emerging evidence of their cost-effectiveness^{168,169} and capacity to improve quality of care,¹²⁹ teaching, documentation and teamwork (by promoting shared mental models and improving human factors),^{122,167,170–173} and mastery of the technique with regular practice¹²⁹ have overcome resistance to change among clinicians,^{174,175} and VL is now practically the gold standard for laryngoscopy and DA management.¹⁷¹

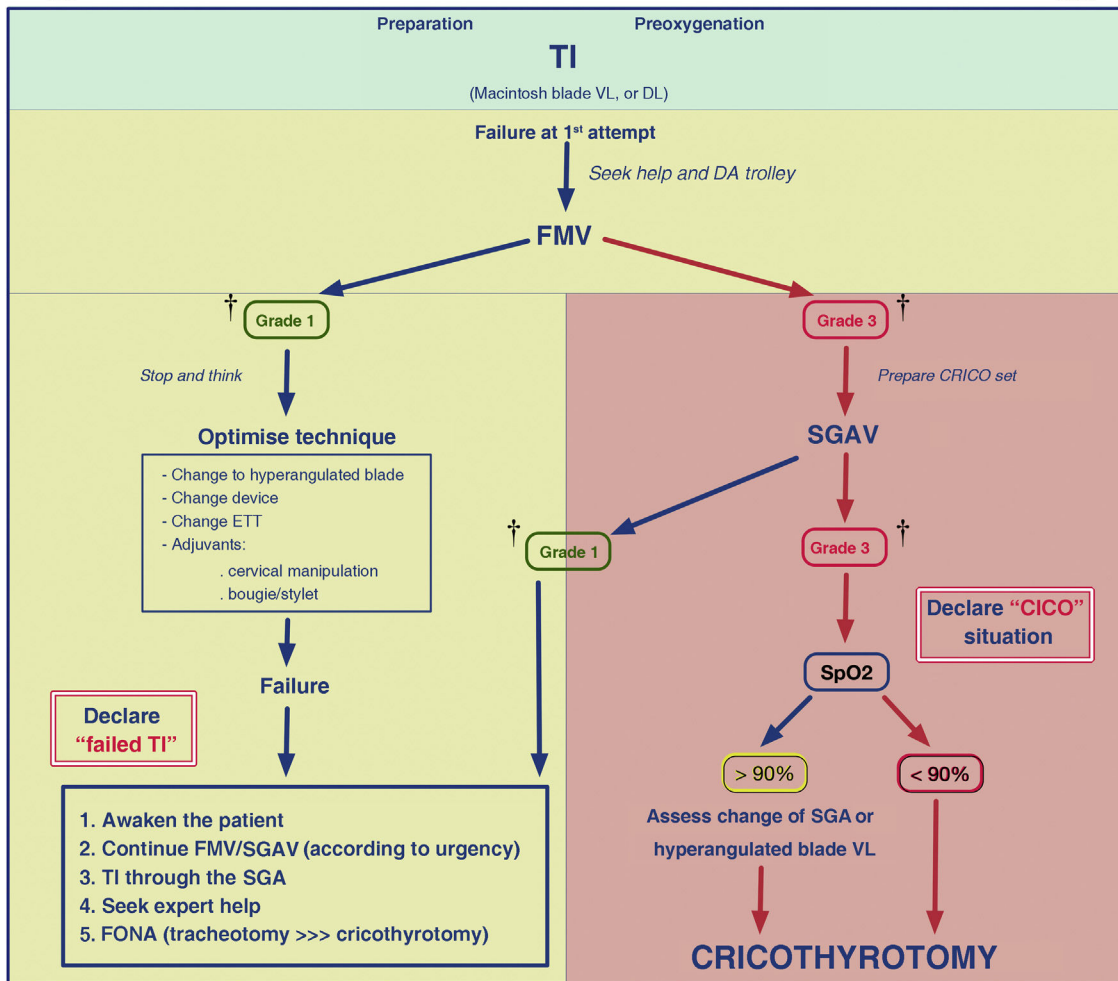
Based on all the aforementioned factors, SEDAR SEMES SEORL-CCC recommend the routine use of VL over DL as first-choice TI device (1B). Standard Macintosh blade devices (allowing both direct and indirect laryngoscopy) are appropriate for managing the airway without predictors of difficulty, while hyperangulated blade devices (with or without a guiding channel) are indicated for known or anticipated difficult airway (EO 94.3%).^{120,135,176,177} Hyperangulated blade devices are first-choice to rescue a failed first attempt.^{14,178–180} Consequently, it is recommended to have a videolaryngoscope available and the necessary expertise in every location where airway management is performed.

Failure to pass the ETT through the glottis is the most common cause of failed VL-guided TI^{166,172,173,181,182}; however, a skilled operator is highly likely to overcome this difficulty.¹⁷¹ Recommended maneuvers to address this difficulty are listed in Table 3.^{182–186}

Introducers are associated with a higher first-attempt success rate in elective and emergency TI, particularly in patients with predictors of DA or impaired glottic views.^{187–190} The availability of a tracheal tube introducer is recommended at all locations where airway management is performed (EO 97.1%)¹⁹¹ and its use should be considered at the first attempt.^{120,185,188,192} SEDAR SEMES SEORL-CCC recommend using an articulating introducer instead of a conventional stylet for TI in patients with DA (1C), as it improves the rate of first-attempt success and expedites



Unanticipated difficult tracheal intubation



* Each “Plan” or non-invasive strategy should be limited to a maximum of 3 attempts.
 * Continuous oxygen therapy throughout the procedure (FMV/VSAD between attempts and apnoeic oxygenation during them)
 * Between attempts, the level of anaesthetic depth and NMB should be checked, and whether there are possibilities for optimisation

Fig. 3 Unanticipated difficult tracheal intubation algorithm. † Ventilation status on capnography waveform. CICO: Can’t intubate, can’t oxygenate; CRICO: cricothyrotomy; DA: difficult airway; DL: direct laryngoscopy; ETT: endotracheal tube; FMV: face mask ventilation; FONA: front of neck access; SGA: supraglottic airway; SGAV: supraglottic airway ventilation; SpO₂: peripheral oxygen saturation; TI: Tracheal intubation; VL: videolaryngoscope.

TI, thus reducing instrumentation and the use of alternative adjuncts.^{60,69,186,193,194}

Recommendation

Flexible fiberoptic bronchoscopy

FOI in unconscious or under GA patients can be highly effective in expert hands^{195–198}; however, it is technically more challenging than in awake patients, it is not fail-safe, leading to episodes of desaturation or complete obstruction of the airway.¹⁰⁵ The presence of blood, emesis, or secretions in the airway of patients requiring emergency TI further reduces the likelihood of success.

Manoeuvres such as tongue pulling and jaw thrusting open the pharynx and larynx, respectively, improving vision and

The routine use of VL is recommended over DL as the first-choice TI device.

Strong recommendation; moderate level of evidence (⊕⊕⊕⊖)

A dynamic or articulating introducer (Flex-tip or FB) is recommended instead of a conventional stylet for TI in patients with difficult airway.

Strong recommendation; low level of evidence (⊕⊕⊖⊖)

the likelihood of success.^{197,199} Oral cannulas, anterior displacement of the tongue base with laryngoscopy, or placing the patient in the left semilateral position with left head

Table 3 Maneuvers to overcome difficulties in videolaryngoscopy-guided tracheal intubation.

Related to device-glottis relationship for vision optimization

- o Choose the correct size, particularly a channelled VL. The bore of the guiding channel determines the exit orientation of the ETT
- o Adjust the distal position of the device by lifting and partially withdrawing it to expand the field of vision and align the blade with the glottis. Channelled VLs optimise TI by centering the glottic view, since the ETT advances towards the glottis at a predetermined angle defined by the configuration of the channel and curvature of the tip of the ETT
- o Perform external laryngeal manipulation (BURP)
- o Increase head elevation
- o Lift the epiglottis with the blade if it is large and obstructs the view of the glottic structures and the passage of the ETT

Related to the use of adjuncts

- o Semi-rigid stylet, either a malleable stylet that can be pre-shaped like a "hockey stick" to match the ETT with the same angulation as the device blade, or the manufacturer's own stylet designed for use with a specific VL. Stylets are mandatory when using VLs with a hyperangulated blade without a guiding channel. As soon as the ETT has passed through the vocal cords, the stylet should be withdrawn to avoid airway injury
- o Static introducer or "bougie" with a curved tip. Rigid bougies are of limited utility because they do not follow the curvature of the blade or the guiding channel. They are more useful with videolaryngoscopes with a Macintosh blade
- o Dynamic bougie or flexible FB that can "negotiate" the acute angle between the glottis and the tip of the ETT

Related to the endotracheal tube

- o Type of ETT. Flexible tubes with a distal silicone end and conical tip
- o Correct ETT size. A smaller size than usual is generally recommended to facilitate passage through the glottis, although excessively small ETTs in channelled VLs can hamper intubation because the large gap between the ETT and the channel means that the tip of the ETT will adopt an excessively posterior position as it emerges from the channel
- o Change the curvature of the ETT
- o Use ETTs with a flexible articulated tip that allows articulation at different angles
- o Rotate the ETT 90° clockwise so that the bevel faces forward, thus reducing the angle of incidence of the ETT when not using intubation adjuncts, or when the stylet is removed before advancing the ETT into the trachea. If using a dynamic bougie or a flexible FB, the ETT should be rotated 90° counterclockwise to position the bevel backwards, overcoming advancement difficulties

BURP: backward, upward, right lateral position; FB: Fibreoptic bronchoscope; TI: tracheal intubation; ETT: endotracheal tube; VL: Videolaryngoscope.

rotation are strategies that facilitate passage of the FB and improve view.²⁰⁰ When ETT encounters resistance, jaw thrust and counterclockwise rotation of the ETT can facilitate passage through the glottis.¹⁹⁸

In the NAP4 Audit, TI failed and an emergency FONA was necessary in all patients undergoing FOI after induction of GA as the primary technique or after failure of DL.

FB, either alone or as part of a multimodal strategy, serves as a highly effective rescue approach following failure of most devices.⁶ However, its availability, preparation, and execution are more labor-intensive and time-consuming than VL in an emergency,^{43,47} so its use as a rescue device is less widespread.²⁰¹

Confirmation of tracheal intubation

After successful TI, it is crucial to immediately rule out oesophageal intubation - a common complication that can have devastating consequences.^{167,202-204}

None of the available techniques for confirming TI are 100% reliable in all circumstances, so they should be used in combination.^{205,206}

Waveform capnography is the most accurate (sensitivity of 98%–100% and specificity of 100%) and rapid method of confirming TI,^{4,120,205,207-212} and is therefore the gold standard (**1B**). Although penetration of waveform capnography as a standard of care remains low,²⁰⁴ it is mandatory to use this technique to confirm ETT placement, and it should be available wherever intubation is performed or may be required.^{167,203,211,213-216} A flat capnography trace (grade 3 ventilation) indicates failed TI until proven otherwise (**EO 80%**)^{211,217} and active steps should be taken to exclude oesophageal intubation.²¹⁸ The capnography trace remains present, though attenuated (not flat), even during cardiac arrest.^{211,212,217-219} EtCO₂ has a lower predictive value when perfusion is low or absent,²¹² and can give false positive readings when the tip of the ETT is in the hypopharynx.²⁰⁵ Confirming TI using point-of-care ultrasound is a valid alternative in these cases, because it has a sensitivity of 99% and a specificity of 97%, is not affected by pulmonary blood flow, takes only 13 seconds on average, and even allows real time visualization of insertion of the ETT into the trachea or oesophagus.^{220,221} The "double trachea sign" allows oesophageal intubation to be detected before starting ventilation.^{216,222}

Colorimetric capnography should only be used when waveform capnography is not available, such as in pre-hospital or emergency settings.²⁰⁵

Clinical examination alone has an unacceptably high false positive rate,²²³ particularly in emergency situations,²²⁴ and confirmation bias can lead to seeing and hearing what one expects,²²⁵ although clinical examination combined with capnography can be useful. Ultrasound or FB examination through the ETT are alternative methods of confirming TI. Other methods include the oesophageal detector device, transtracheal illumination, pulse oximetry, and chest x-ray.²⁰⁵

Capnography waveform monitoring during mechanical ventilation is highly recommended in all settings (EO 100%),^{207,209,211,226–230} as it allows continuous monitoring of the ETT position, confirms airway patency, and provides early diagnosis of accidental extubation or partial displacement of an artificial airway.^{211,218,227,229,231–233} The NAP4 audit found that absence of monitoring might have contributed to more than 70% of airway-related deaths in the ICU,²³⁴ so the widespread adoption of capnography in critical care units and training medical and nursing staff in its use^{211,217,218} could be the single most impactful change in preventing morbidity and mortality arising from TI or the use of other artificial airways outside the operating room.^{211,234}

Recommendation

Capnography waveform is the gold standard for confirming alveolar ventilation.

Strong recommendation; moderate level of evidence (⊕⊕⊕⊖)

Ventilation with a supraglottic airway

SGAs, in addition to their use as a primary technique in elective surgical procedures or cardiopulmonary resuscitation,^{235–237} are essential for rescuing a difficult or failed TI, since they enable ventilation and oxygenation, maintain airway patency with a certain degree of protection against aspiration, and act as conduits for FOI.^{238–243} Insertion and function of an SGA is not usually affected by the anatomical and/or technical factors that prevent effective FMV and TI.²³⁹ Therefore, an SGA should be inserted without delay to preserve alveolar oxygenation in the event of difficult or failed TI (EO 85.7%).

2GSGAs possess most of the ideal characteristics: they are easy to insert, provide high oropharyngeal sealing pressures, facilitate gastric decompression, and can be used as a conduit for TI.^{49,239,244} Thus, they have demonstrated superior performance compared to first-generation devices and are more suitable for advanced uses and as rescue devices.^{244–246} Therefore, the immediate availability of a 2GSGA and the necessary competence for its use are recommended in all locations where airway management is performed (EO 100%).

The selection of an SGA for rescuing a DA should be made prior to the procedure. Devices with a high first-attempt ventilation success rate that can be used as a conduit for TI are the first choice^{238,247}: i-gel™ (Intersurgical Ltd., Wokingham, United Kingdom), Ambu® AuraGain™ (Ambu A/S, Ballerup, Denmark), LMA® Protector™ (The Laryngeal Mask Company Limited, Mahé, Seychelles) and iLTS-D (VBM Medizintechnik GmbH, Sulz, Germany).

An optimal attempt or a maximum of 3 attempts is recommended before declaring a failed plan, since the success rate significantly decreases with successive attempts,^{248,249} and these increase trauma and delay the transition between plans. If cricoid pressure has been applied, it must be released during placement of an SGA (EO 80%). Each new attempt must include a change that improves the chances of success. Periprocedural oxygenation methods must continue both between and during attempts.

Rapid insertion and correct placement of the SGA is essential for securing the airway.²⁵⁰ Ninety degree rotation, jaw thrust, and the use of DL or VL (first choice) with the “insert-detect-correct as you go” technique facilitate SGA placement, increase the first-attempt success rate while reducing pharyngeal trauma (EO 82.9%),^{246,250–257} and can prevent malpositioning.^{257,258} Blind insertion, however, results in malpositioning in 50%–80% of cases,^{246,256,257} leading to suboptimal airway control, leaks or obstruction, increased risk of further displacement, and increased morbidity.^{251,255,259} Malpositioned SGAs are 26 times more likely to cause gastric insufflation followed by aspiration.²⁵⁵ Table 4 shows the requirements for an ideal SGA position, the causes of malpositioning, and how to correct them.^{246,255} The recently developed video laryngeal mask (VLM)²⁵⁹ can be placed under direct vision, and malpositioning can be immediately corrected without the need for additional devices,⁶⁶ although more evidence on their use is required.^{259–264}

Correct placement of an SGA is confirmed clinically by a normal capnography waveform (grade 1 ventilation) and the maintenance of adequate alveolar oxygenation with peak inspiratory pressures of 20 cmH₂O and an oropharyngeal leak pressure >25 cm H₂O. Lung auscultation and successful passage of a tube through the gastric canal are complementary signs.²⁵⁹

Achieving effective ventilation and oxygenation provides time to stop and think about the next step, depending on the degree of urgency and type of procedure:

- 1 If the situation is not urgent (e.g., elective surgical procedure), the safest option is to wake the patient and perform the surgery under regional anaesthesia or postpone the intervention in order to perform ATI.
- 2 If the situation is urgent due to: (a) emergency surgery: the team may decide to go ahead with surgery with the 2GSGA, although this is a high-risk option due to the potential compromise of airway patency during surgery; (b) critically ill patient: a definitive airway is likely to be required, so a FONA (tracheostomy) can be performed to prevent potentially fatal hypoxaemia.
- 3 In intermediate cases, FOI through the SGA can be performed if the situation is stable, NMB is adequate, and the operator has the required skills (EO 97.1%, success rates close to 100%²³⁸). Blind TI is not recommended due to its low success rate (10%–20%), the need for repeated

Table 4 Requirements of an ideal position of a SGA, causes of malpositioning and how to correct them.

SGA properly placed (good seal and no leaks)

Requirements of an ideal position

- 1 Distal tip of the cuff in the esophagus
- 2 Epiglottis resting on the outside of the cuff
- 3 Tip of epiglottis aligned with the proximal cuff
- 4 Cuff adequately inflated to produce a seal (pressure 40–60 cm H₂O)
- 5 No crease in the cuff (silicone is better than PVC)

Avoid:

- Cuff hyperinflation (SGA dislocation)
- Cuff hypoinflation (risk of aspiration)
- Too deep/too small SGA
- Too shallow/too large SGA

Malpositioned SGA confirmed with video laryngoscopy²⁵⁵ (leaks and airway obstruction)**Causes**

- 1 Tip of distal cuff
 - a. folding over
 - b. folding backward
 - c. located between the vocal cords
- 2 Epiglottis in bowl of SGA
 - a. without downfolding
 - b. downfolding epiglottis
 - c. epiglottis folding double

Correction:

- Jaw thrust to open the oropharyngeal space (increase the distance between the epiglottis and the posterior wall of the oropharynx) in order to reposition the SGA²⁶⁸
- Use a different size or type of SGA (change from PVC cuff to silicone cuff or reinforced tip)
- Railroad the SGA over an introducer or orogastric tube²⁶⁹
- Use Magill forceps²⁷⁰

SGA: supraglottic airway.

Adapted from Van Zundert AA, et al.²⁴⁶

attempts, and the potential for causing greater trauma and deterioration of oxygenation.^{265,266} A VLM allows the operator to perform TI without FB guidance,⁶⁶ so it can shorten intubation time and may be particularly advantageous when FB is not available, such as in the prehospital and emergency setting.²⁶⁷

Grade 2–3 ventilation or ineffective oxygenation after exhausting all attempts requires immediate progression to a new plan.

Face mask ventilation

FMV is an essential transition technique during anaesthesia induction and management of the emergent airway, and an indispensable rescue plan when other techniques fail.²⁷¹

The presence of predictors of difficult FMV, as well as its use during an emergent airway or as a rescue from failed plans, makes it especially advisable to use the optimal technique from the outset (the triple airway manoeuvre

of head extension, jaw thrust and mouth opening, placement of a nasopharyngeal or oropharyngeal cannula²⁷² and the two-handed “VE” technique^{271,273} performed either by 2 operators or with pressure-controlled ventilation from a ventilator or other device^{274,275} in a patient with optimal positioning under intense NMB^{271,276–280} (EO 80%) in order to limit airway obstruction and optimize mask sealing to achieve grade 1 alveolar ventilation without causing gastric insufflation.^{126,275,281} This speeds up the transition between plans and reduces the maximum ventilation pressure.²⁸² Face mask ventilation with a modified triple airway manoeuvre is recommended over the “CE” technique in the general population (1C).

Successful FMV must be defined as stable or improved SpO₂, acceptable tidal volume and airway pressure (4–5 ml/kg and <15–20 cmH₂O, respectively^{273,275,283}), and the presence of a plateau phase on capnography.²⁸⁴ It is advisable to use scales to objectively stratify the difficulty of FMV, such as the instrument developed by the Japanese Society of Anaesthesiologists (Fig. 2, Part I). This allows

the declaration of a failed FMV attempt before desaturation occurs (late sign).²⁷⁵

FMV is a dynamic procedure that must be continuously monitored until the airway has been secured.²⁸⁵ The declaration of failed FMV necessitates an immediate transition to SGAV (EO 85.7%). Clinical deterioration and worsening oxygenation should prompt the declaration of CICO and an immediate transition to FONA if SGAV has also failed.

A CICO situation should be declared using clear language that is easily understood by all and creates a shared model that will facilitate effective transition to FONA.^{119,286}

Recommendation

Face mask ventilation with a modified triple airway manoeuvre is recommended over the “CE” technique in the general population.

Strong recommendation; low level of evidence
(⊕⊕⊖⊖)

Front of neck access techniques

Failure of all 3 non-invasive supraglottic plans (primary and rescue) in an apneic patient necessitates the verbalization of CICO and the prompt execution of FONA regardless of the SpO₂ value (EO 90.6%), because in these circumstances deterioration is either imminent or already evident. In in-hospital CICO situations, the SEDAR SEMES SEORL-CCC recommend asking for an ENT specialist (or surgeon trained in tracheostomy) as soon as CICO has been declared, although no procedure should be delayed while waiting for their arrival.

Delayed FONA is a leading cause of morbidity and mortality.^{99,234,247,287,288} Situational awareness and shared decision-making, together with good training in technical skills and human factors management will eliminate the psychological barriers to relinquishing further attempts at non-invasive techniques.^{99,119,287,289–291} Cognitive aids can help alleviate stress and speed up the transition to FONA²⁹² (Fig. 1, Part I).

Teams should be prepared both psychologically and technically before declaring a CICO situation, and for this purpose the “double setup” may help²⁹³: one team performs conventional airway management while a second team stands by ready to perform FONA if needed. Multidisciplinary approach is more likely to secure the airway faster and at the first attempt.

It is recommended to continue providing 100% oxygen via a supraglottic route, ensure intense NMB^{127,294} and the neck must be extended to expose the larynx.²⁹⁵

There are 3 emergency FONA techniques: percutaneous cricothyrotomy, surgical cricothyrotomy, and surgical tracheotomy.

Cricothyrotomy is the technique of choice in a CICO situation (EO 91.4%) because it is relatively simple, fast, and has a high success rate with few complications.^{100,296} However, the presence of an experienced ENT specialist or surgeon

allows for a tracheostomy to be performed with the same efficacy and safety as a scalpel cricothyrotomy.^{297,298} Therefore, if an ENT specialist is present, he or she should perform FONA using the technique they consider most appropriate.

Cricothyrotomy can be either surgical or percutaneous. The evidence to support any single FONA technique is weak. The few comparison studies published have been performed in simulation or animal models,⁹⁹ therefore, it is impossible to recommend one technique over the other.^{99,101,299–302} However, surgical cricothyrotomy is successful in practically 100% of cases.^{234,287,303}

The SEDAR SEMES SEORL-CCC recommend performing surgical cricothyrotomy using the scalpel-bougie-tube technique (EO 91.4%) for the following reasons^{98–100,234,247,287,291,294,301,304,305}: (1) the equipment needed is available in all settings; (2) it can be performed by a single operator; (3) it has a short learning curve; (4) although it is psychologically more challenging,^{300,306,307} it is a simple, rapid technique; (5) it permits a large bore ETT or cuffed cannula to be inserted into the trachea to definitively secure the airway, protect against aspiration, and achieve effective gas exchange with conventional PPV that can be confirmed with capnography; (6) it is both safe and effective. The equipment includes a scalpel with a number 10, 20 or 21 blade, an ETT or cannula with a bore of up to 6 mm, and a bougie.

Other cricothyrotomy techniques are also valid, provided they are performed by an experienced operator using the correct equipment. Percutaneous cricothyrotomy to re-establish oxygenation and adequate ventilation involves inserting either a ≥ 4 mm tube with a 15 mm connector, or a wide-bore cannula techniques.^{247,291,294,301,305,308} The SEDAR SEMES SEORL-CCC leave it to the operator to decide whether to use percutaneous cricothyrotomy as their first-choice or rescue technique,³⁰⁹ and therefore recommend acquiring skills in more than one technique.^{300,302,310} The operator’s experience, the availability of the material, and the characteristics of the patient will determine the technique used.^{99,101,294,297,309,311} The percutaneous technique, being more familiar and less intimidating, could be initiated earlier.³⁰⁰

The success of the technique relies on identification of the cricothyroid membrane (CTM). Identification by palpation is prone to error. Ultrasound is recommended over palpation to identify the CTM (1C), so the SEDAR SEMES SEORL-CCC recommend acquiring the necessary skills. The laryngeal handshake technique (by palpation), though slightly more time-consuming than conventional techniques, is associated with a higher success rate.^{312,313} When the anatomy of the neck makes it difficult to identify the CTM by palpation, the operator should perform a vertical cutaneous incision measuring more than 4 cm in the midline of the neck in a distal-proximal direction above the sternal notch to identify the relevant anatomy.^{98,247,314} Ultrasound, though superior to palpation in identifying the CTM,^{315–319} can be time consuming, so in a CICO situation it should only be used if it is immediately available and the operator has the required training.

After securing the airway with FONA, adequate ventilation and alveolar oxygenation should be confirmed by capnography waveform, clinical evaluation, pulse oximetry and arterial blood gases when indicated.²⁹⁴ The examina-

tion can be complemented by a fibrobronchoscopic and radiological study. Emergency cricothyrotomy should be converted to an ETT or tracheostomy in a timely fashion, as there is insufficient evidence to support its long term use (EO 85.7%).^{296,320} The cricothyrotomy tube should be replaced with a tracheostomy within 72 h to avoid subglottic stenosis.^{301,321}

Failure of a cricothyrotomy to secure the airway makes it advisable to perform a tracheostomy by an experienced operator (EO 94.3%).¹⁰⁰

According to the NAP4 audit, CICO situations account for 39% of critical events and 25% of all anaesthesia-related deaths.²⁸⁷ FONA is the last resort when non-invasive plans have failed, so it is vitally important.³²² Each institution should protocolise the technique used, and a commercial or pre-assembled cricothyrotomy kit should be available wherever airway management is performed.^{99,247,311,323} The kit should be placed in an easily accessible transparent bag, ideally in the DA trolley, so that the team can become familiar with its contents and mentally rehearse the procedure. All clinicians involved in airway management must acquire and maintain the skills needed to perform a surgical or percutaneous cricothyrotomy using the Seldinger technique (EO 100%).^{99,101,119,247,291,298,301} The performance of FONA should be feasible at any location where airway management is conducted (EO 100%).³²⁴

Recommendation

The use of ultrasound is recommended over palpation to identify the cricothyroid membrane

Strong recommendation; low level of evidence
(⊕⊕⊖⊖)

The prehospital setting

Prehospital airway management is essential for patient survival, and is a major challenge for Emergency Medical Services (EMS).^{325,326} Different factors and limitations come together in each scenario to create a high level of uncertainty that transforms any ordinary airway into a DA,³²⁷ and it is not always possible for patient and operator to be positioned as described in intubation guidelines (patient trapped, confined, crushed, buried, or inaccessible). Survival depends on effective coordination of the entire emergency care chain. Table 5 shows the distinguishing characteristics of prehospital airway management.^{328,329}

Human and ergonomic factors

Using a standardised RSI protocol will optimize outcomes, reduce the cognitive burden in high-stress situations, and improve technical and non-technical performance. Therefore, it is advisable to standardize the contents and layout of the airway management bag or "kit dump", and have a checklist on hand.³³⁰ Fig. 4 shows our suggested contents and

ergonomic layout of the airway management bag suggested by SEDAR SEMES SEORL-CCC for the prehospital setting.

Airway management bag

All the airway material is stowed in the bag using a standardised, modular design so that it is always visible and accessible in less than a minute. The material needed for each of the four treatment plans is stowed in a separate compartment separated by Velcro® or zippers, and marked with easily recognizable pictograms.³³¹ Each compartment must contain at least 1 airway device for each plan (see Fig. 4).

For field use, bags, cases, or backpacks must be easy to carry (reasonable size and weight), made of officially approved flexible, water- and corrosion-proof material of an easily identifiable colour that is clearly labelled and can be easily washed and sterilize. They must have both handles and straps to enable them to be carried on the back to keep the hands free for care procedures. They should ideally be checked daily, and also at each change of shift, following a checklist.

Ergonomics of positions during airway management

Pre-hospital care of critically ill patients relies on teamwork, usually made up of a physician, a nursing component, and one or more technicians. Therefore, there is a single operator.

The airway approach will vary greatly, depending on the many different scenarios, risks, patients, positions, and obstacles encountered. Each intervention is unique and unrepeatable. The emergency team must access and control the scene, identify the most seriously ill patient, determine their priorities, and establish more than one approach plan. The patient will usually be lying on the ground allowing for a safety roll, although this is not always possible. Tracheal intubation on the ground is a predictor of DA.³³² Non-standard positions create varying degrees of airway access difficulties, so it is important to bear in mind the anatomical changes and the pathophysiology associated with each position (Fig. 5). However, in an ideal scenario, the SEDAR SEMES SEORL-CCC suggest arranging team members as shown in Fig. 4. The physician is situated at the head of the patient and controls ventilation and airway. A technician is situated on his or her right to assist with the technique (Sellick, BURP, jaw thrust, handing over material, etc.). The nursing member and the second technician are positioned at the patient's left shoulder/arm, while the airway management bag is placed on the patient's right, and the monitor is placed at the patient's feet where it can be clearly seen by all team members. If the patient is in cardiac arrest, the monitor should be placed by the patient's left shoulder to facilitate manoeuvres.

Pre-procedure assessment and planning

A DA encountered in the pre-hospital setting is, by definition, unanticipated. However, it is still essential to evaluate the airway in order to anticipate possible difficulties and

Table 5 Characteristics of pre-hospital airway management.

Guidelines Procedures Safety	<ul style="list-style-type: none"> • No fundamental concepts or standardised training program. • Research presents complex methodological challenges. • Highly complex evaluation, quality control, and patient safety procedures. • Low level of evidence. • Incomplete or unsatisfactory protocols (no cognitive aids, outdated).
Setting	<p>Particularly complex setting (contextual difficult airway)</p> <ul style="list-style-type: none"> • Patient’s home, public street, or inside the ambulance • Confined space and/or inaccessible • Adverse context (infinite combinations): adverse weather conditions, excessive or poor lighting, noise, social pressure. • Difficult access. Non-standard patient/operator positioning during intubation. • Highly stressful situation.
Patient and pathology	<ul style="list-style-type: none"> • Highly complex clinical context • Emergency indication: imminent loss of the airway, no spontaneous breathing, impaired level of consciousness or agitation. • Physiologically difficult airway: haemodynamic instability, shunt, V/Q mismatch ↓ FRC, full stomach. • Anatomically difficult airway. • No information on patient’s background and clinical history.
Operator	<ul style="list-style-type: none"> • Single operator relatively inexperienced in airway management given their multidisciplinary training. • Only 1 chance at securing an airway (oedema, tracheal haemorrhage, etc.)
Equipment	<ul style="list-style-type: none"> • Equipment not adapted to the prehospital setting (extreme temperatures, lighting). • Less effective (e.g., less powerful portable aspirators). • Limited availability.
Airway management	<ul style="list-style-type: none"> • Transporting the patient involves added risks that must be anticipated and planned: <ul style="list-style-type: none"> - Accidental extubation in an uncontrolled environment. - Clinical and haemodynamic deterioration: early, delayed, and late. • The use of specific pre-transportation checklists can prevent complications. • Contingency plans must be in place for special circumstances (non-stop journeys, air transportation, limited space or difficult access). • Intubation must be guided by capnography.

FRC: Functional residual capacity; V/Q mismatch: ventilation/perfusion mismatch.

plan the treatment.³³¹ Predictive tests can be challenging to use, and often there is only time for a “one second look”. Although this quick evaluation can be useful, it should be combined with other tests as far as possible.³³³

The following independent predictors of DA in the pre-hospital setting have been described in the literature: (1) airway obstruction, patient lying on the ground, and thyromental distance of less than 3 fingers,³³² (2) cramped conditions, short neck, obesity, facial and neck injuries, mouth opening less than 3 cm, and ankylosing spondylitis,³³⁴ (3) Glasgow scale >3, limited neck movement, trismus/jaw clenched, inability to palpate landmarks on the neck, presence of blood or vomit in the airway.³³⁵

Teams dealing with an unanticipated DA should also have experience in ATI, although the indications are more limited in emergency TI.^{336,337}

Periprocedure oxygenation

Apnoeic oxygenation significantly reduces hypoxaemia during emergency TI,^{338,339} so this, together with preoxygenation, is essential in prehospital airway management.³⁴⁰ Patients should be oxygenated using a standard nasal cannula at 15l/min before induction and until the ETT is in place, except in the case of epistaxis, severe head trauma with possible skull base fracture, or complex facial fractures, because it could worsen intubating conditions and potentially cause pneumocephalus.³³¹

Any factor that may affect airway management must be optimized before attempting TI to make sure that the first attempt will be the best.

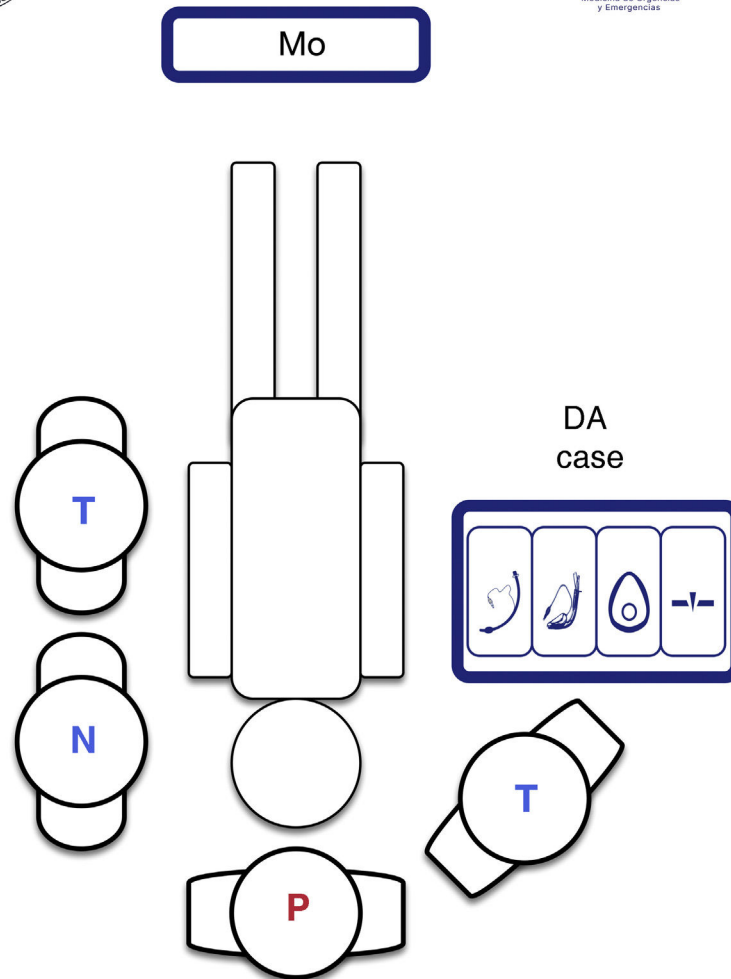


Fig. 4 Placement of team members and materials in an Ideal Prehospital Setting. DA: difficult airway; N: nurse; Mo: monitor; P: physician; T: technician.

Rapid sequence induction

RSI is the most widely used induction technique in the pre-hospital setting. However, alternative techniques should also be available.⁹⁵ It is advisable to follow a standardized checklist-based RSI protocol that includes drugs and dose calculation, and all the material required.³⁴¹

Cardiopulmonary resuscitation

Any abnormal situation increases the delay in achieving ventilation and alveolar oxygenation, interrupts chest compressions, and delays the return of spontaneous circulation (ROSC).³⁴²

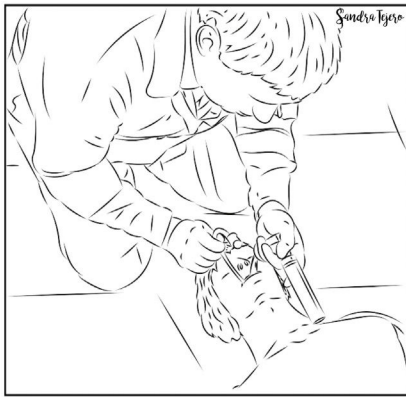
According to current evidence, there are no significant differences between non-invasive airway management plans.³⁴³⁻³⁴⁵ Outcomes are determined by TI success rates. Therefore, if the desired level of TI efficacy is not achieved, preference should be given to establishing ventilation and

alveolar oxygenation over a specific treatment plan, and airway management should not interfere with resuscitation interventions, such as chest compressions, defibrillation, and treatment of the reversible causes of the cardiac arrest.³²⁸

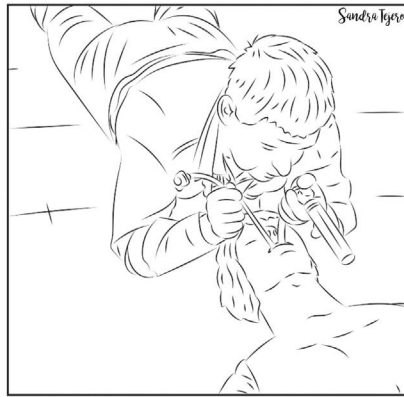
Severe trauma

Severe traumatic brain injury carries a high risk of airway obstruction, pulmonary aspiration, hypoxia, brain injury, and death.³⁴⁶ Pre-hospital TI is beneficial when performed by experienced practitioners following standardized protocols.^{346,347} Pre-hospital TI together with air transport could reduce overall mortality by 47%.³²⁶

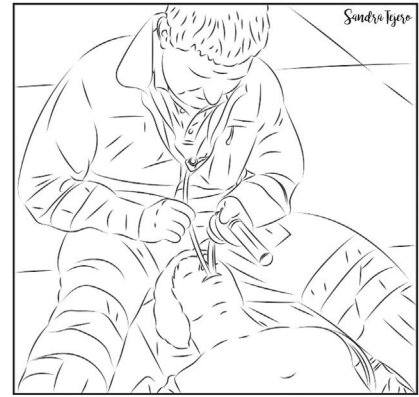
Various factors can complicate airway management,³⁴⁸ including: (1) possibility of an unstable cervical spine injury requiring bimanual alignment; (2) contamination or flooding of the airway by tissue, vomit, secretions, blood, etc. This requires aggressive management with manual removal



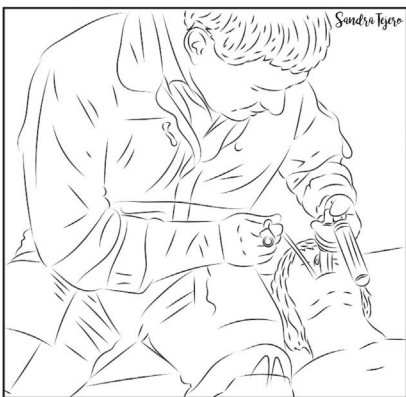
Position 1. Operator kneeling.
Allows good application of force by the left hand, although requires the operator to have dorsal flexibility. However, poor axis alignment may make laryngoscopy and oesophageal intubation difficult.



Position 2. Operator in prone position.
The axes are much more favourable. The left arm reduces its lever arm and, therefore, the axial traction force.



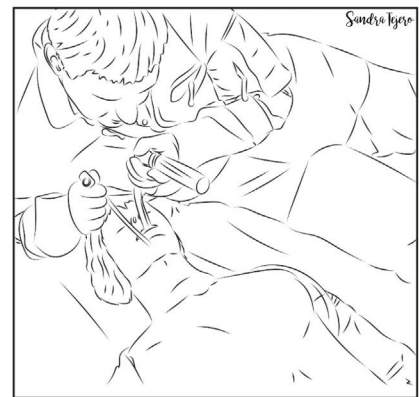
Position 3. Operator seated at the patient's head.
Good application of force. Poor axis alignment. Useful for narrow spaces.



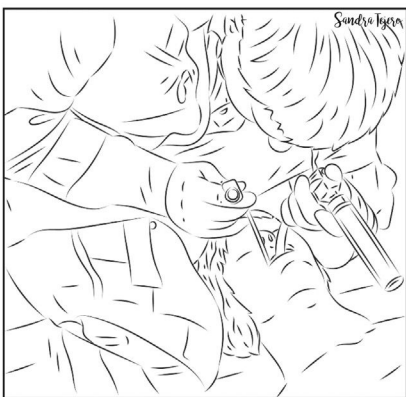
Position 4. Operator seated at the patient's side.
Very complex.



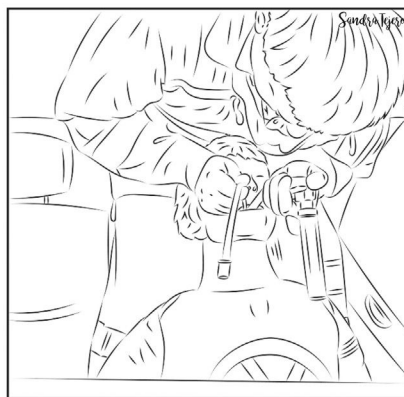
Position 5. Operator straddling the patient's chest (reverse frontal).
Requires change of hands. Allows good application of force. Axis alignment is not good. Usually requires support to maintain balance.



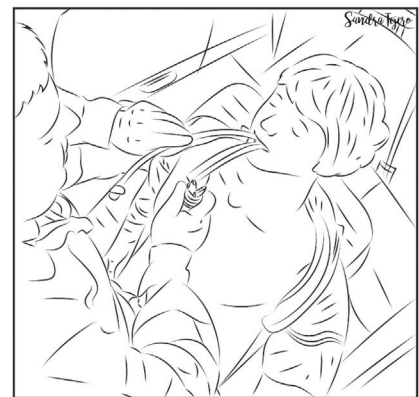
Position 6. Operator in right lateral decubitus.
Very complex. While the position reduces the power of the left arm, supporting the right arm reduces its level of precision. Useful for left-handers, with left-handed blades



Position 7. Operator in left lateral decubitus. Paris SAMU position.
Very interesting. Increases the traction power of the left arm, which also has a lateral traction component due to the position, and further opens the airway. The right hand retains its precision.



Position 8. Operator above and behind the patient.
Requires flexibility. Laryngoscopy is simple. The axes are good. Support is often required. With the patient upright, the need for gravity traction is reduced



Position 9. Operator facing the patient.
Requires a change of hands. Enables application of force and laryngoscopy

Fig. 5 Strategies for intubating difficult access airway.

of fragments and aspiration of secretions using the SALAD (suction assisted laryngoscopy and airway decontamination) technique³⁴⁹; (3) uncooperative or agitated patient; (4) facial bone fractures; (5) **Direct Airway Trauma**: Both pen-

etrating and blunt trauma (burnt airway and/or inhalation syndrome). The presence of penetrating cervical trauma is the most common indication for ATI, while the highest incidence of FONA is reported in patients with maxillofacial trauma.^{348,350}

In these conditions, RSI and VL-guided TI with a hyperangulated blade and preconfigured stylet are recommended^{348,351} The procedure can be affected by sunlight reflecting off the screen or contamination of the airway by blood or vomit.³⁵² If a VL is not available, an SGA or DL with reduced traction can be used.³²⁹ The use of DL may increase the risk of cervical spine injury.^{348,350}

Patient trapped, buried, crushed, or inaccessible

This represents the paradigm of contextual difficult airway. To deal with this setting, teams need to acquire additional skills in order to take part in rescue support manoeuvres (8 modalities) and work in hostile environments.³⁵³

Cuff pressure monitoring

A large percentage of laryngotracheal morbidity is related to improper establishment of cuff pressure.³⁵⁴ Underinflation can cause hypoventilation or increase the risk of aspiration, while excessive pressure, even for short periods, can cause hoarseness, sore throat, impaired ciliary motility, and injuries such as mucosal inflammation and ischaemia, laryngeal oedema, ulcers, stenosis, tracheoesophageal fistula, tracheomalacia, tracheal rupture, vocal cord paralysis, or nerve injury.^{241,355–357} The incidence of these complications has declined since the introduction of low-pressure, high-volume cuffs³⁵⁸; however, these devices still cause preventable injuries.^{94,359}

Intermittent monitoring with manometry of cuff pressure is desirable after establishment and periodically during maintenance^{360–364} (not applicable in crisis situations). The use of continuous monitoring to constantly maintain cuff pressure within a desired range in critically ill patients could reduce the risk of ventilator-associated pneumonia.^{365–367} A manometer should be used for continuous monitoring of cuff pressure (1C).

Cuff pressure must be established with the minimum pressure needed to guarantee a safe, effective seal. Cuff pressure should remain between 20–30 cm H₂O (ideally lower than 25 cm H₂O) in ETTs and tracheostomy and cricothyrotomy cannulas, and <60 cm H₂O in the case of SGAs (EO 94.3%)^{241,354,358,368–371} from insertion to extraction. If the seal is inadequate even at these pressures, it may be necessary to reposition or re-size the device.³⁷²

Nitrous oxide spreads into the cuff,³⁵⁹ so pressure should be re-measured after 20 min, at which time the pressure will have stabilized, and again if nitrous oxide concentration increases.³⁷³

Recommendation

A manometer should be used for continuous monitoring of cuff pressure

Strong recommendation; low level of evidence
(⊕⊕⊖⊖)

Extubation

Tracheal extubation is a high-risk procedure that has a major physiological impact.³⁷⁴ It may trigger a haemodynamic stress response, coughing, laryngospasm or agitation which may in turn increase intracranial or intraocular pressure.^{375–378} Laryngotracheal protective reflexes remain impaired for several hours after extubation, facilitating aspiration. Extubation failure occurs when a patient is unable to maintain adequate oxygenation and ventilation, clear secretions, or maintain airway patency, and can have catastrophic consequences, particularly in patients with a DA.³⁷⁶ Airway obstruction is the main cause, and is usually associated with post-obstructive pulmonary oedema and severe hypoxia.³⁷⁸ Failed extubation, generally defined as the need for reintubation within 24–72 hours, occurs in approximately 0.1%–0.45% of patients undergoing general anaesthesia.³⁷⁹ Prevalence increases 10-fold in patients with sleep apnoea-hypopnea syndrome (SAHS) or in those undergoing airway surgery, and another 10-fold in patients treated in the ICU.³⁸⁰ Failed extubation can potentially lead to severe adverse outcomes.^{381–383} One third of all cases of anaesthesia-related deaths or permanent brain damage are due to failed extubation.^{288,384} Poor anticipation and planning for “at risk” extubation are core issues.^{288,384} Extubation is an elective procedure that must be prepared, executed a stepwise strategy, and meticulously followed up.^{375,376,378,385} Fig. 6 shows a cognitive aid for planning extubation based on risk assessment.

The main objective in tracheal extubation is to preserve oxygenation and avoid reintubation. Reintubation should always be considered potentially difficult due to the additional complexity involved (EO 97.1%, distorted anatomy with restricted access, secretions, blood or oedema, time constraints, and highly stressful setting).^{375,376,385} Anatomical, physiological and contextual risk stratification^{376,383,386,387} determines the likelihood of successful extubation on the basis of tolerance to extubation and the feasibility of reintubation, and allows to establish an individualized strategy and optimise the patient’s status in anticipation of airway-related and physiological factors, such as hypoxaemia, hypercapnia, residual NMB, hypothermia, or airway oedema.^{355,383,387} The leak test,³⁸⁸ preferably quantitative (leak volume <110 ml or <12%–24% of delivered tidal volume determines diminished airway patency and risk for postextubation stridor due to laryngeal oedema^{387,389}), ultrasound evaluation,^{390,391} and laryngeal visualization with VL or FB can be used to evaluate airway patency and identify periglottic oedema or bleeding before extubation, thereby facilitating decision making (EO 97.1%),³⁵⁵ although none of these are specific predictors of successful extubation.³⁹²

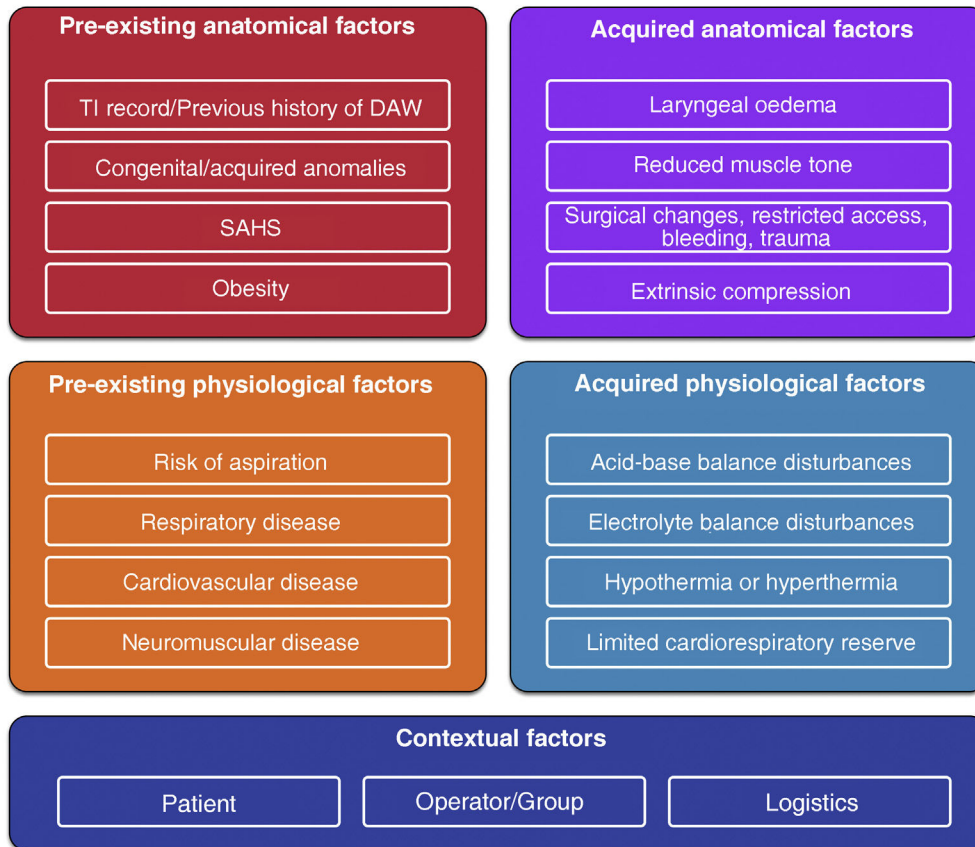
Once the decision has been made to proceed with extubation, the first step is to review the original TI and re-evaluate the airway and overall risk factors.³⁸³ Careful advance preparation, notifying the team of potential problems and early warning signs, and establishing appropriate rescue plans for oxygenation and reintubation if the primary strategy fails will help ensure safe, successful extubation.^{378,383} Important considerations before extubation include³⁷⁸: (1) preoxygenate until extubation; (2) aspirate visible airway secretions or blood, ideally using a laryngoscope to avoid



Risk-based planning for tracheal extubation



Assessment of risk factors



Planning

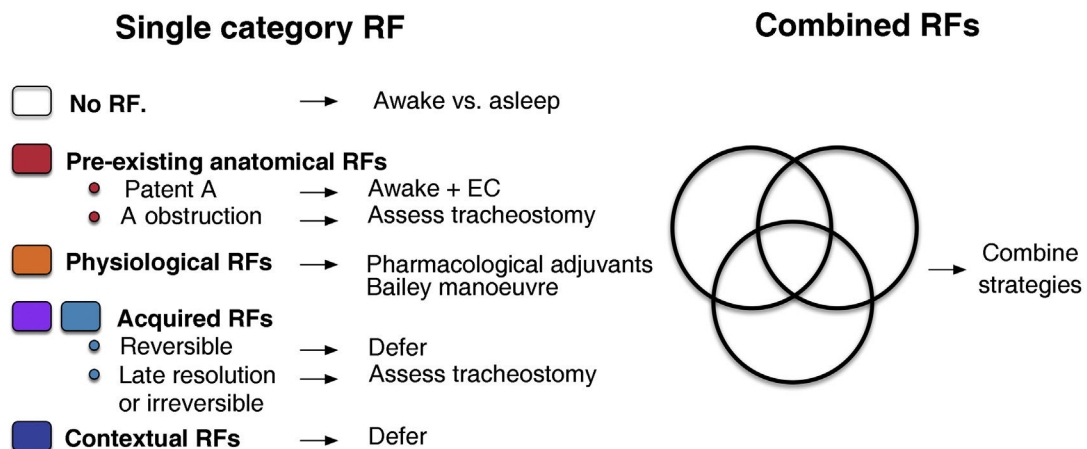


Fig. 6 Cognitive aid for extubation: planning, risk stratification and decision making.

A. airway; Adj: adjuvants; DA: difficult airway; EC: exchange catheter; RF: risk factors; SAHS: sleep apnoea-hypopnea syndrome; TI: tracheal intubation.

soft tissue trauma; (3) place a bite bloc³⁸⁶; (4) properly positioning the patient; (5) reverse NMB. Neuromuscular monitoring in combination with reversal agents to achieve a train-of-four ratio of ≥ 0.90 is essential to avoid residual NMB^{393–396}; (6) minimise head and neck movements and reduce noxious stimuli to avoid laryngospasm; (7) emergence to an awake state.^{377,378,385–387} Deep extubation is inappropriate in patients with DA or risk of aspiration^{377,386}; (8) apply positive pressure, deflate the cuff, and remove the ETT; (9) administer 100% oxygen, confirm airway patency and adequate spontaneous breathing; (10) maintain continuous oxygen therapy until full recovery, along with surveillance, monitoring, and qualified assistance to handle potential emergent tracheal reintubation.³⁸⁵ DA equipment must be prepared and immediately accessible.

Prophylactic administration of corticosteroids before elective extubation significantly reduces the incidence of airway-related post-extubation adverse events and reintubation, so patients at high risk of obstruction could benefit from this strategy.^{397–399} In patients with an absent or reduced cuff leak, administration of a corticosteroid at least 4 h before extubation is advised.^{376,387,389} Prophylactic administration of corticosteroids is recommended before extubation in patients at high risk of airway obstruction (**1B**).

Various advanced techniques have been developed for high-risk extubation, but these should only be performed by clinicians experienced in each technique.³⁷⁸ Administration of pharmacological adjuvants,^{400–405} such as infusion of remifentanyl,⁴⁰⁶ or performing the Bailey manoeuvre, which involves the placement of a SGA over the ETT followed by the removal of the ETT,⁴⁰⁷ may be considered when smooth emergence and attenuation of undesirable cardiovascular or respiratory responses are required.^{408–410} The use of VLM for TI could play a significant role in making this manoeuvre safer and simpler, as it allow for the easy withdrawal of the ETT through its ventilation channel under direct vision and reinsert it immediately if required.⁶⁶ Both techniques require a deep level of anesthesia for their execution, so they may be inappropriate in patients at risk of aspiration and in whom reintubation may be difficult.^{1,378}

Awake extubation and the use of advanced techniques is the most suitable approach in patients with a difficult airway (**EO 94.3%**), as the maintain airway patency and muscle tone, protective reflexes, and spontaneous breathing.⁴¹⁰ Airway exchange catheters are usually used to rescue extubation in patients with anticipated or known DA.¹ These devices can be left in place after extubation if reintubation is likely,³⁷⁶ in which case an ETT can be railroaded over the catheter under direct vision.¹⁸⁵ They can also be used to deliver low-flow oxygen or jet ventilation in the event of life-threatening hypoxaemia, although this should be avoided as far as possible, since even low flows have been known to cause barotrauma.⁴¹¹ Reintubation with an airway exchange catheter is successful in 92% of cases, with a first attempt success rate of 87% vs 14%. They are associated with a low incidence of oesophageal intubation and desaturation, bradycardia, and hypotension.⁴¹² The main risks of the technique are airway stimulation, injury due to subcarinal insertion, and accidental dislodgement of the catheter. In adults, they should never be inserted deeper than 25 cm from the lips.³⁷⁸ Staged extubation sets, con-

sisting of a guide wire and reintubation catheter,^{413,414} are associated with an overall success rate of 93%⁴¹⁵ and appear to improve tolerance at the expense of increased risk of accidental dislodgement.⁴¹⁶ If reintubation over an intubation catheter is necessary, reducing the gap between the ETT and the catheter, administering adequate NMB, and using a VL to visualise the advance of the ETT facilitate the procedure by preventing arytenoid and epiglottic impingement.^{383,417} Other recommendations to facilitate FOI are applicable to exchange catheter-guided TI. If re-intubation fails, the operator must follow the unanticipated DA algorithm.

Waveform capnography should be available in recovery units and should be used in high-risk patients (**EO 97.1%**). After extubation, oxygen therapy with nasal prongs and face mask with capnography waveform monitoring will promptly detect respiratory depression, hypoventilation, hypercapnia or post-extubation airway obstruction.^{379,387}

Strategies to prevent extubation failure include head tilt and administration of supplemental oxygen. A good oxygenation strategy with NIV or HFNO can avoid reintubation in at-risk patients.^{374,418–421}

Recommendation

Prophylactic administration of corticosteroids is recommended before extubation in patients at high risk of airway obstruction

Strong recommendation; moderate level of evidence (⊕⊕⊕⊖)

Documentation

The airway management process must be detailed in a report that can orient future intubations. In addition to the informed consent and the results of the preintubation pre-procedure airway evaluation, the report should detail the techniques used for periprocedure oxygenation, topicalization, awake sedation, induction, the devices, adjuncts and ETT used, the approach (right nasal, left nasal or oral), number of attempts, the extubation strategy, and any difficulties or complications encountered. [Supplementary data 5](#) shows an airway management report template.

A history of failure in previous procedures is the most accurate predictor of failure in subsequent treatments (**EO 97.1%**).⁴²² Reporting difficulty is one of the most important ways of preventing future complications. The report facilitates decision-making and forms the basis for a structured, targeted approach that ensures an efficient transition and reduces airway instrumentalization by steering away from plans that have been unsuccessful in the past.^{422,423} Using a variety of resources to report a DA will increase the likelihood of this critical information fulfilling its purpose.^{423,424} For example^{11,294,424}: (1) a detailed description of the successful technique used together with a visual record with images and/or video of the anatomy and the technique can be added to the patient's clinical history⁴²⁵; (2) the patient and their next of kin or caregiver can be notified

verbally in person; (3) the patient can be given a written report. [Supplementary data 6](#) shows our suggested DA notification template; (4) the patient can be issued with a medical alert bracelet, necklace or ID card with a QR code for access to clinical information. [Supplementary data 7](#) shows our suggested DA alert wearables; (5) a DA alert can be programmed to pop up whenever the patient's electronic record is accessed; and (6) the patient can be registered in national or international DA databases.⁴²⁶ The registration form should be standardised, and should include mandatory fields describing the characteristics of the airway, the nature of the difficulty, the techniques that failed and succeeded, and a free text field for additional information.^{294,424} Using structured difficult airway notes in electronic records has been shown to reduce the number of adverse events.^{427,428}

Organisational aspects of airway management

The implementation of airway strategies requires not only individual commitment, but also a proactive attitude on the ministerial, institutional and departmental levels.^{429,430} The action plan to improve the safety, cost-effectiveness and quality of airway management includes: (1) standardising the techniques and equipment used across all locations wherever airway management is performed, effective adherence to guidelines, standardising the DA trolley,⁴³¹ eliminating barriers and promoting facilitators to encourage compliance with guidelines^{432–434}; (2) coordinating all departments involved in airway management (anaesthesia, intensive care, emergency, otolaryngology, and prehospital care); (3) acquiring and ensuring accessibility of the right equipment; (4) providing staff with training and opportunities for continuous professional development; (5) performing periodic audits and introducing a human error prevention program: a) analysing airway-related incidents, b) identifying and addressing departmental and institutional factors that may have contributed to the event in order to learn from mistake and make improvements, c) reviewing cases and discuss alternative plans; (6) implementing a system for reporting and notifying airway-related incidents⁴³⁵; (7) introducing a system of coding, registering, identifying and warning of DAs; (8) drafting organizational guidelines on the use of resources and continuous improvement.^{436,437}

Each institution should appoint an "Airway Lead" (EO 100%)^{11,429,430,438} - a clinician with experience in the field who liaises with hospital management to ensure local policies and organisation are implemented. The airway lead's primary objective is to provide each member of staff with the tools they need.^{429,439} In order to improve safety, some hospitals have formed multidisciplinary specialist teams with clearly defined roles.^{440–442} The creation of a national network of airway leads and airway teams would further improve airway management and patient safety.^{438,439}

Decisions to acquire airway devices must be supported by a formal, evidence-based evaluation.^{24,443,444}

Education and training

Airway management is an essential skill in anaesthesiology, critical care, and prehospital and emergency medicine.^{445,446}

Poor training is a common causal or contributing factor in complications^{234,384} and undermines the operator's confidence in performing essential techniques, such as FOI and cricothyrotomy.^{447–449} Optimizing teaching and training are key to improving safety.³²²

There is scant evidence on airway management curricula, and training is not standardized,^{324,450} so strategies used in other specialist fields have been adapted to airway management training. Good training should include both cognitive skills based on theoretical principles, and technical and non-technical skills.^{322,451} Skills must be acquired gradually through a process of theoretical, simulation-based, and clinical training with problem solving until the learning curve has been completed. Instructors must give evaluation and feedback in each phase of learning (EO 100%).^{437,452,453} Competency-based training must be individualized.⁴⁵⁴ Training should follow a mastery learning approach that consists of achieving pre-defined standard learning objectives involving mastery of a particular skill before moving on to a higher level of difficulty and stress.⁴⁵⁵ Mastery learning is a student-centred, evidence-based method⁴⁵⁶ that could give better results.^{457,458}

Education and training must be structured in such a way as to address all aspects of airway management,^{37,322,445,455} with emphasis on core, versatile skills, and skills to be used in critical emergency situations.⁴⁴⁵ Standardization of a training program is highly recommended.³²² Simulation-based training is important for acquiring non-technical skills, such as teamwork, using guidelines and cognitive aids in clinical practice, and practising procedures and resolving life-threatening issues that would rarely be encountered in real-world practice.^{437,448,455,459–464} Guidelines and algorithms are tools for learning skills and strategies, and can be used as a reference during debriefing,^{322,465,466} while cognitive aids are useful when practising procedures in simulation-based training.^{127,322} Structured debriefing improves clinical knowledge and the acquisition and implementation of skills in clinical practice.^{455,467}

More senior operators may be at risk of providing lower quality care,^{446,468} and therefore require a continuing education and training program, preferably annual, with refresher courses to acquire the new skills needed to use the latest devices or new techniques and to maintain their existing skills^{322,445,455,469,470} (EO 97.1%).⁴⁷¹ Both hospital management and individual clinicians must take a proactive approach to training. It is highly recommended that each service appoint a local airway leader to organise top quality interprofessional, multidisciplinary training programs with defined learning goals, evaluations, and supervision, and to ensure that guidelines and cognitive aids are disseminated and followed.^{322,324,439,445,448,472} Training must be diversified to provide the operator with several alternatives.⁴³ [Supplementary data 8](#) shows the skills that we believe should be included in all airway management training programs, as well as the teaching methods needed to achieve these objectives.

Summary of recommendations derived from the systematic literature search

Search strategies and GRADE tables are shown in [supplementary data](#).

No.	Recommendation	Level of evidence	Grade of Recommendation
Pre-procedural assessment and planning			
1.	The diagnosis of SAHS is a predictor of difficult mask ventilation.	Low	Strong
2.	The diagnosis of SAHS is a predictor of difficult tracheal intubation	Moderate	Strong
3.	Gastric ultrasound is recommended to evaluate the likelihood of aspiration in high-risk patients	Low	Strong
Preparation			
4.	The capnography waveform is the gold standard for confirming alveolar ventilation.	Moderate	Strong
5.	In obese patients, the ramp position or a 30° head-up tilt is recommended to improve tracheal intubation conditions	Low	Strong
6.	Ramping prolongs the safe apnoea time in obese population	Moderate	Strong
Periprocedure oxygenation			
7.	HFNO should be considered the first-line preoxygenation technique for patients with mild hypoxaemia	Low	Strong
8.	NIV should be prioritised over conventional oxygen therapy for anaesthesia induction in obese patients.	Moderate	Strong
9.	Apnoeic oxygenation should be performed with high-flow nasal cannulas (NO DESAT/HFNO)	Low	Strong
Rapid sequence induction			
10.	Neuromuscular blockade should be performed to improve TI conditions and reduce the incidence of intubation-related adverse events in the general population	Moderate	Strong
11.	The combination rocuronium + sugammadex is not inferior to succinylcholine in RSI	Moderate	Strong
Unanticipated difficult airway			
<i>Tracheal intubation</i>			
12.	The routine use of VL is recommended over DL as the first-choice TI device.	Moderate	Strong
13.	A dynamic or articulating introducer (flex-tip or fiberoptic bronchoscope) is recommended instead of a conventional stylet for TI in patients with difficult airway.	Low	Strong
14.	The use of the Parker Flex-Tip ETT is recommended over conventional ETTs for FOI in the general population.	Moderate	Strong
15.	The Parker Flex ETT is suggested instead of conventional ETTs for FOI and laryngoscopy to reduce the risk of complications in the general population.	Low	Strong
<i>Face mask ventilation</i>			
16.	Face mask ventilation with a modified triple airway manoeuvre is recommended over the "CE" technique in the general population.	Low	Strong
<i>Front of neck access</i>			
17.	The use of ultrasound is recommended over palpation to identify the cricothyroid membrane.	Low	Strong
Cuff pressure monitoring			
18.	A manometer should be used for continuous monitoring of cuff pressure.	Low	Strong
Extubation			
19.	Prophylactic administration of corticosteroids is recommended before extubation in patients at high risk of airway obstruction.	Moderate	Strong

AW: airway; DL: direct laryngoscopy; ETT: endotracheal tube; FOB: fiberoptic bronchoscopy; HFNO: high flow nasal oxygen therapy; NIV: non-invasive ventilation; NOT DESETT: Nasal oxygen therapy during efforts to secure an ETT; RSI: Rapid sequence induction; SAHS: Sleep apnoea-hypopnoea syndrome; TI: tracheal intubation; VL: videolaryngoscopy.

Expert opinion derived from the results of the Delphi questionnaire

No.	Statement	% in favour [for; neutral; against]
Human factors		
1.	No more than 3 attempts should be made in each non-invasive airway management plan	88.6 [31; 2; 2]
2.	The first attempt must be made under optimal conditions	100 [35; 0; 0]
3.	The most appropriate first-line technique should be the one that gives the greatest likelihood of achieving success on the first attempt.	94.3 [33; 1; 1]
4.	Clinicians should use visual cognitive aids to deal with emergencies	97.1 [34; 1; 0]
5.	A standardized difficult airway trolley should be placed near any room where airway management is performed	100 [35; 0; 0]
6.	Checklists should be used to reduce human error, speed up tasks, and promote an airway management safety culture	100 [35; 0; 0]
7.	Systems that promote ergonomics and communication models should be implemented	91.4 [32; 3; 0]
Pre-procedural assessment and planning		
8.	A pre-procedure evaluation should be performed in all patients who require airway management	100 [35; 0; 0]
9.	Pre-procedural airway assessment should be multifactorial, structured, and aimed at detecting anatomical, physiological, and contextual difficult airway	97.1 [34; 1; 0]
10.	The airway assessment can begin by detecting predictors of difficulty or failure for the primary plan and subsequently for the three alternative plans	97.1 [34; 1; 0]
11.	Multivariate models could have greater predictive capacity	97.1 [34; 1; 0]
12.	Decision-making must be individualized to the patient, operator, context, and time of day	97.1 [34; 1; 0]
13.	Intake of food and liquids should be restricted according to preoperative fasting guidelines	97.1 [34; 1; 0]
14.	A full stomach is an indication for TI to protect the airway	88.6 [31; 2; 2]
Preparation		
15.	Waveform capnography must be available at all locations where airway management is performed to confirm successful ventilation with any of the 4 plans used	97.1 [34; 1; 0]
Difficult airway management: basic options		
16.	A pre-intubation risk-benefit analysis must be performed to determine the suitability of the airway management technique	97.1 [34; 1; 0]
17.	Awake airway management is recommended when TI is likely to be highly difficult or impossible, or when there are composite predictors of difficulty, physiological alterations, and negative contextual issues	82.9 [29; 5; 1]
18.	General anaesthesia with preserved spontaneous breathing should be induced whenever awake tracheal intubation is advisable but general anaesthesia is unavoidable due to lack of cooperation or the urgency of the situation, and when there are no predictors of physiological or context-related difficulties or obstructive airway pathology	91.4 [32; 2; 1]

19.	In patients with predictors of physiological or context-difficulties, postponement can be considered if it outweighs the risk of proceeding with airway management, or alternative anaesthesia strategies can be considered	85.7 [30; 5; 0]
<i>Known or anticipated difficult airway</i>		
20.	Awake tracheal intubation is the technique of choice in patients with known or anticipated difficult airway	85.7 [30; 4; 1]
21.	High-flow nasal oxygen therapy is recommended over conventional low-flow cannulas	91.4 [32; 3; 0]
22.	NIV through an endoscopy face mask could be useful when intubating critically ill patients with hypoxaemia	82.9 [29; 6; 0]
23.	Premedication with an antisialogogue, preferably glycopyrrolate, is recommended to optimize the local anaesthetic effectiveness and improve the field of vision.	80 [28; 5; 2]
24.	Sedation is an optional complement to adequate topical anaesthesia in awake tracheal intubation	88.6 [31; 2; 2]
25.	The goals of conscious sedation in awake tracheal intubation are effective amnesia, patient satisfaction, and analgesia to reduce coughing, gagging, and haemodynamic reflexes while preserving airway patency, spontaneous breathing, and protective laryngeal reflexes.	94.3 [33; 2; 0]
26.	If the first-line technique (FB or VL) fails, the alternative technique should be used.	80 [28; 6; 1]
27.	A third attempt may benefit from a multimodal approach (VL + FB)	100 [35; 0; 0]
28.	The combination of intubating SGA and FOI can be a useful rescue technique to maintain oxygenation and airway patency and be used as a conduit to facilitate TI	100 [35; 0; 0]
29.	A smaller calibre ETT than usual is recommended when performing FB and VL.	85.7 [30; 4; 1]
30.	There should be less difference between the external diameter of the FB and the internal diameter of the ETT in order to facilitate FOI.	85.7 [30; 3; 2]
31.	Standard PVC ETTs are not recommended for FOI as they are more likely to impinge on the glottic structures.	71.9 [23; 4; 5]
32.	After visual confirmation of tracheal intubation, general anaesthesia should be induced after inflating the cuff and confirming intubation with capnography.	94.3 [33; 2; 0]
33.	Fallback techniques and approaches should be planned in advance and implemented without delay after failure of the primary technique.	100 [35; 0; 0]
34.	A FONA plan must be prepared before attempting awake tracheal intubation if it is likely to fail and result in complete airway obstruction.	88.6 [31; 4; 0]
35.	Awake tracheostomy under local anaesthesia should be performed in patients with pre-existing critical airway compromise.	82.9 [29; 6; 0]
36.	Awake cricothyrotomy would be the most appropriate technique in the event of emergency critical airway compromise.	91.4 [32; 3; 0]
37.	Awake ECMO under local anaesthesia may be the safest option when all 4 conventional plans are likely to be impossible, to fail, or to be ineffective and the patient is at risk of complete airway obstruction.	90.6 [29; 1; 2]

Unanticipated difficult airway

Periprocedure oxygenation

38. HFNO should be considered the first-line preoxygenation technique for patients with mild hypoxaemia ($\text{PaO}_2/\text{FiO}_2 > 200$ mmHg), while NIV is the technique of choice in those with severe hypoxaemia ($\text{PaO}_2/\text{FiO}_2 \leq 200$ mmHg). 87.5 [28; 3; 1]
39. Preoxygenation with NIV + HFNO and apnoeic oxygenation with HFNO should be a priority in critically ill patients undergoing TI. 85.7 [30; 4; 1]

Rapid sequence induction

40. RSI is the recommended technique when there is a considerable risk of aspiration in an airway without predictors of difficulty 97.1 [34; 1; 0]
41. RSI, with or without the Sellick manoeuvre, should be performed in all emergency TIs 84.4 [27; 1; 4]
42. An RSI checklist should be used to improve patient safety 97.1 [34; 1; 0]
43. Patients with high risk of aspiration should be premedicated with a nonparticulate antacid immediately before induction or an H_2 receptor antagonist or a proton pump inhibitor 40–60 min before induction to increase pH and reduce the volume of gastric contents 82.9 [29; 5; 1]
44. Use of a nasogastric tube should be individualized 88.6 [31; 4; 0]
45. High-efficiency, large-calibre, multi-hole suction instruments must be readily available to treat possible regurgitation 100 [35; 0; 0]
46. A 20–30° head-up position is recommended to prevent passive regurgitation. Should this occur, the patient should be placed in the Trendelenburg position with the head turned to one side to aspirate fluid from the pharynx and trachea before starting PPV 94.3 [33; 2; 0]
47. The choice, dose, and rate of administration of hypnotic agent must be individualized 91.4 [32; 3; 0]
48. In agitated, non-cooperative patients, delayed sequence induction can be considered to achieve adequate preoxygenation. 71.9 [23; 3; 6]
49. The routine use of cricoid pressure cannot be recommended 81.3 [26; 2; 4]
50. A "modified RSI" can be used in patients at high risk of hypoxia who are not candidates for awake tracheal intubation 85.7 [30; 5; 0]

Tracheal intubation

51. Videolaryngoscopes with standard Macintosh blade (which allow for both direct and indirect laryngoscopy) are appropriate for tracheal intubation in patients without predictors of difficulty, while those with hyperangulated blade (with or without a guiding channel) are indicated in patients with known or anticipated difficult airway. 94.3 [33; 1; 1]
52. The availability of a tracheal tube introducer is recommended at all locations where airway management is performed. 97.1 [34; 1; 0]
53. A flat capnography trace (grade 3 ventilation) indicates failed TI until proven otherwise. 80 [28; 6; 1]
54. Capnography waveform monitoring during maintenance of mechanical ventilation is highly recommended in all settings 100 [35; 0; 0]

Ventilation with a supraglottic airway

55. An SGA should be inserted without delay to preserve alveolar oxygenation in the event of difficult or failed TI 85.7 [30; 3; 2]

56.	Immediate availability of a 2GSGA is recommended, along with the necessary proficiency for its use in all locations where airway management is conducted.	100 [35; 0; 0]
57.	If cricoid pressure has been applied, it must be released during placement of an SGA	80 [28; 5; 2]
58.	A 90-degree rotation, jaw thrust, and the use of DL or VL (of choice) with the "insert-detect-correct-as-you-go" technique enhance the efficacy and safety of SGAs by facilitating insertion, increasing the success rate on the first attempt, and reducing pharyngeal trauma.	82.9 [29; 4; 2]
59.	FOI can be performed through the SGA if the situation is stable, NMB is adequate, and if the operator is skilled in the technique	97.1 [34; 1; 0]
Mask ventilation		
60.	The optimal mask ventilation technique should be used as first-line the triple airway manoeuvre of head extension, jaw thrust and mouth opening, placement of a nasopharyngeal or oropharyngeal cannula and the two-handed "VE" technique in a patient with optimal positioning under intense NMB.	80 [28; 3; 4]
61.	The declaration of failed mask ventilation necessitates an immediate transition to SGAV.	85.7 [30; 2; 3]
Front of neck access		
62.	The failure of the 3 non-invasive plans (primary and rescue), regardless of the SpO ₂ value, requires the verbalization of CICO and subsequent execution of FONA.	90.6 [29; 0; 3]
63.	Cricothyrotomy is the technique of choice in a CICO situation	91.4 [32; 2; 1]
64.	The scalpel-introducer-tube cricothyrotomy technique is recommended	91.4 [32; 2; 1]
65.	The performance of FONA should be feasible at any location where airway management is conducted.	100 [35; 0; 0]
66.	Emergency cricothyrotomy should be converted to ETT or tracheostomy, as there is insufficient evidence to support its use as long-term treatment	85.7 [30; 3; 2]
67.	Failure of a cricothyrotomy to secure the airway makes it advisable to perform a tracheostomy by an experienced operator.	94.3 [33; 1; 1]
68.	All clinicians involved in airway management must acquire and maintain the skills needed to perform a surgical or percutaneous cricothyrotomy using the Seldinger technique.	100 [35; 0; 0]
Cuff pressure monitoring		
69.	Cuff pressure should be established with the minimum pressure needed to guarantee a safe, effective seal. Cuff pressure should remain between 20–30 cm H ₂ O in ETTs and tracheostomy and cricothyrotomy cannulas, and <60 cm H ₂ O for SGAs	94.3 [33; 1; 1]
Extubation		
70.	Reintubation should always be considered potentially difficult due to the addition complexity involved	97.1 [34; 1; 0]
71.	The cuff leak test, preferably using a quantitative evaluation technique, ultrasound evaluation and laryngeal visualization with VL or fiberoptic bronchoscope can facilitate decision-making.	97.1 [34; 1; 0]
72.	Awake extubation and the use of advanced techniques is the most suitable approach in patients with difficult airway	94.3 [33; 2; 0]
73.	Waveform capnography should be available in recovery units and should be used in high-risk patients	97.1 [34; 1; 0]

Documentation		
74.	A history of failure in previous procedures is the most accurate predictor of failure in subsequent treatments.	97.1 [34; 1; 0]
Organisational aspects of airway management		
75.	Each institution should appoint an “Airway Lead”	100 [35; 0; 0]
Teaching and training		
76.	Skill acquisition should be gradual, involving a cognitive phase, simulation, and clinical training with problem-solving until the learning curve is completed, with evaluation and feedback from the instructor at each stage.	100 [35; 0; 0]
77.	Continuing education and regular training are required for the development of new skills or techniques and the maintenance of competencies, preferably on an annual basis.	97.1 [34; 1; 0]

ATI: awake tracheal intubation; DA: difficult airway; DL: direct laryngoscopy; ECMO: extracorporeal membrane oxygenation; ETT: endotracheal tube; EtCO₂: end-tidal carbon dioxide concentration; EtO₂: end-tidal oxygen concentration; FOB: fiberoptic bronchoscopy; FiO₂: inspiratory fraction of oxygen; FMV: Face mask ventilatio; FONA: front-of-neck access; 2GSGA: second generation supraglottic device; HFNO: high flow nasal oxygen therapy; IC: informed consent; NIV: non-invasive ventilation; NMB: neuromuscular blockade; PaO₂: arterial partial pressure of oxygen; RSI: rapid sequence induction; SGA: supraglottic device; SGAV: supraglottic airway ventilation; SpO₂: peripheral oxygen saturation; TI: tracheal intubation; VL: videolaryngoscopy.

Authors' contribution

- Manuel Á. Gómez-Ríos: drafting of the manuscript, preparation of all cognitive aids and graphic material, tables and annexes, literature review, critical reading, levels of evidence, final revision of the document.
- José Alfonso Sastre: Draft of RSI sections, SGA, and checklist, risk factor tables, information document models, literature review, critical reading, levels of evidence, final revision of the document.
- Xavier Onrubia-Fuertes: FONA contribution, unanticipated difficult tracheal intubation, literature review, final revision of the document.
- Teresa López: Draft of SGA and ECMO sections, literature review, critical reading, levels of evidence, final revision of the document.
- Alfredo Abad-Gurumeta: literature review, critical reading, levels of evidence, final revision of the document.
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- Jon Alexander Sistiaga-Suárez: critical reading, final revision of the document.
- Manuel Bernal-Sprekelsen: critical reading, final revision of the document.

- Pedro Charco-Mora: Coordination, Algorithm for unanticipated difficult tracheal intubation, draft ergonomic options, draft teaching and training, literature review, critical reading, final revision of the document.

Conflict of interests

MAGR received lecture honoraria from Medtronic.

XOF received honoraria for lecture and practical workshop on neuromuscular block from Merck Sharp & Dohme.

RCF received honoraria for lectures from Fresenius Kabi.

AAG received honoraria for lectures from Merck Sharp & Dohme and 3 M Edwards.

Delphi expert panel

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A list of contributors can be found in the [supplementary data](#).

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