# NEW RECOMMENDATIONS OF THE AMERICAN ASSOCIATION OF ANESTHESIOLOGY (2022) FOR THE MANAGEMENT OF DIFFICULT AIRWAY

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## Abstract

Difficulty establishing an airway and lung ventilation is one of the most urgent conditions in medicine, which can lead to severe complications, including permanent neurological damage and death. To facilitate handling this difficult clinical situation, various guides and recommendations were created to increase patient safety, help doctors, and protect them from criminal liability. The American Society of Anesthesiologists (ASA) issued new recommendations in 2022, which cover all segments of this problem, starting with the clear definition of different clinical situations (difficult laryngoscopy, difficult tracheal intubation, difficult face mask ventilation, difficult placement supra, and infraglottic means), through recommendations for the preparation of care for difficult airway, to algorithms and strategies for solving anticipated and unanticipated difficult airway. The paper presents the most important aspects of the mentioned segments of the new ASA recommendations, as well as their comparison with previous ASA recommendations and recommendations of other associations.

**Keywords:** difficult airway, management, recommendations, American Society of Anesthesiologists

## Introduction

Establishing an airway and ventilation is necessary for all patients with inadequate lung ventilation due to respiratory insufficiency (or cessation), regardless of the etiology, although there are other indications for performing this procedure, such as a tracheobronchial toilet in comatose patients who breathe sufficiently[1]. Regardless of the indications for assisted or artificial ventilation, the fact is that this intervention can be very difficult to perform. Any delay in initiating lung ventilation can have fatal consequences. A few minutes of gas exchange interruption can lead to irreversible changes in the cerebral circulation, resulting in permanent neurological damage and/or death[2]. The reasons for difficult airways are numerous. They are most often associated with the patient itself: congenital or acquired anatomical deformities (primarily in the face, neck, and chest), physiological factors, risk of aspiration, infections, comorbidities, the urgency of the procedure, and other factors, and can also be iatrogenic: medical team knowledge and proficiency, preparedness, presence of stressors (such as fatigue, illness, etc.), decision-making ability, team dynamics (such as inadequate team leadership or inadequate division of roles within the team, and more). Also, risk factors for difficult airways can be associated with the environment and the institution (limited space in which the procedure is performed, lack of appropriate equipment, etc.) and numerous other factors[3, 4].

The American Society of Anesthesiologists released new guidelines in 2022 for managing difficult airways[5]. Given the importance of timely and appropriate airway management, particularly because over 40% of anesthesia-related deaths are related to difficult airway establishment and breathing (i.e. complications that may occur during these procedures), it is crucial to be familiar with modern recommendations and guidelines in this area. One of the strongest pieces of evidence of the magnitude of this problem is certainly the National Project of Great Britain and Ireland, which lasted three years and whose results were published in 2011. The focus of the project was the outcome of nearly three million tracheal intubations. It was shown that severe complications (permanent neurological damage or death) occurred in 184 patients. It was concluded that these outcomes could have been avoided with better planning, better monitoring (especially capnography), earlier recognition of complications, and therefore better education and training of the medical team[6].

In addition to ASA recommendations, there are also recommendations from other associations dealing with this issue, which should also be known and applied in situations


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where they seem most appropriate[7-9]. This primarily refers to the Difficult Airway Society (DAS) of Great Britain and Ireland, which leads to the quality of the offered solutions. The latest DAS guidelines were presented in November 2015 (and supplemented in 2018, 2019, and 2020), and they have brought significant progress in this field[10, 11].

ASA issued its last recommendations in 2011, with added supplements in 2013, so they were largely lagging behind the actual situation in clinical practice, especially in terms of improving equipment for difficult airway management[12]. Therefore, it is clear that the new ASA recommendations (from 2022) differ significantly from their old recommendations (from 2011), but are very similar to the DAS recommendations (from 2015), and in many segments, they are almost identical. This paper will consider the basic elements of the new recommendations: new definitions of difficult airways and ventilation, recommendations for preparing for airway management, and proposed strategies for addressing this problem, including algorithms for appropriate actions. Each of these elements will be considered in terms of the benefits of the new approach, as well as the drawbacks that also exist.

## The new definitions

In the following text, new ASA definitions related to difficult airway and/or difficult ventilation of the lungs are presented, along with a comparison with old ASA definitions and definitions from other associations or authors, highlighting differences, similarities, advantages, or limitations of this new definitions[5].

Definition for difficult airway "It involves a clinical situation in which expected or unexpected difficulties arise in establishing the airway, including face mask ventilation, laryngoscopy, supraglottic airway ventilation, tracheal intubation/extubation, and invasive airway management." This definition represents a significant improvement compared to the previous ASA definition, which stated that a "difficult airway is a clinical situation where either intubation or ventilation with a face mask is difficult, or both problems are present simultaneously." The new definition is more comprehensive and includes not only difficult mask ventilation and difficult intubation but also difficult supraglottic airway device insertion and difficult front-of-neck airway access (FONA).

Difficult mask ventilation is "the situation when it is not possible to provide adequate ventilation (i.e. confirm the presence of carbon dioxide at the end of expiration through capnography), due to one of the following issues: inadequate mask seal, excessive gas leak, or excessive resistance to air entry or exit." This definition has its shortcomings because it includes reasons for difficult mask ventilation by mentioning only three reasons, while it is clear that there are more than three (older age, toothlessness, obesity, snoring, sleep apnea, mandibular protrusion, male gender). The reasons for difficult mask ventilation have been proven in numerous studies, but they are all contained in acronyms offered by Walls & Murphy, such as MOANS (Mask seal, Obesity/Obstruction, Age, No teeth, Sleep apnea/Stiff lungs), MMMASK (Male gender, Mask seal, Mallampati grade 3 or 4, Mandibular protrusion, Age, Snoring/Sleep apnea, and Kilograms), OBESE (Obese, Bearded, Edentulous, Snoring, Elderly), and others[13, 14]. It seems that the best definition of difficult mask ventilation was given by Han[15], who graded the success of face mask ventilation into four levels: easy mask ventilation (first level), ventilation that is not entirely easy but provides good oxygenation (second level), inadequate mask ventilation to maintain oxygenation, unstable ventilation or ventilation that requires the assistance of a second person (third level), and the most severe situation, the fourth level, when mask ventilation is impossible, end-tidal $CO_2$ is absent (on capnography), and visible chest movement during attempts at positive pressure ventilation is absent despite the use of auxiliary devices and the involvement of additional staff[15].

Difficult laryngoscopy is "the situation when visualization of any part of the vocal cords is not possible after multiple attempts of laryngoscopy" (this definition is correct and does not offer anything new compared to previous ASA definitions and definitions of other associations).

Difficult or impossible tracheal intubation is "tracheal intubation that requires multiple attempts or inability to intubate after multiple attempts." This definition also represents a significant advancement compared to the previous ASA definition, which stated, "When an experienced anesthesiologist needs more than three attempts or longer than 10 minutes to place a tube." Numerous studies have shown that it is not rational to attempt more than three times or longer than 10 minutes, as it can significantly endanger the patient, so limiting the number of attempts is incorporated into all newer recommendations, algorithms, and guides[6, 8-10].

Difficult or incorrect extubation is the "loss of airway patency and inability to provide adequate ventilation after removal of the endotracheal tube or supraglottic device in a patient with known or suspected compromised airway" (nothing new in this definition).

Difficult or impossible ventilation with supraglottic devices is a situation where "it is not possible to provide adequate ventilation due to the presence of one or more of the following problems: difficult placement of the endotracheal tube, multiple attempts required for endotracheal tube placement, inadequate adherence of the endotracheal tube, excessive air leakage, or excessive resistance to air entry or exit." It gives the impression that this definition is not clear enough because it refers to two separate entities, i.e. it combines them: difficult or impossible insertion of a supraglottic device, such as a Laryngeal Mask Airway (LMA),

and the inability to ventilate using a SAD (LMA failure). Difficult/impossible SAD placement is defined as the inability to insert a SAD in an adequate position that would allow satisfactory ventilation after three attempts. The inability to ventilate with a supraglottic device is any event related to the airway that requires the removal and repositioning of the LMA or tracheal intubation. So initially, after the placement of the LMA, ventilation could have been satisfactory, but then something happened that prevented adequate lung ventilation (often related to repositioning the patient after LMA placement)[16]. Also, the new ASA definition does not take into account the reasons why the insertion of LMA or ventilation using it was difficult or impossible, unlike the definitions of other associations, which usually include reasons for difficult airway establishment and/or ventilation using a certain method[17]. It should certainly include the most common/important reasons for difficult/impossible LMA insertion, which are well illustrated by the Walls RODS scale: Restricted mouth opening, Obstruction, Disrupted or distorted airway, Stiff lung or cervical spine[13].

Difficult or unsuccessful invasive establishment of the airway "occurs if there are anatomical structures or deformities that reduce the chances of a successful approach to the trachea from the front of the neck." This definition offers nothing new compared to previous ones. In this case, Murphy and Walls SHORT scale seems to provide better insight into the reasons for difficult access to the trachea from the front of the neck: Surgery or other airway obstruction, Hematoma, including infections and abscess, Obesity, Radiation or other reasons for neck deformity, Tumors, including goiters in the neck region. In the work of Lou and colleagues, these reasons are grouped into two groups of problems: 1) a problem with FONA (due to a thin neck or accompanying pathology or a fixed cervical spine or flexion deformities of the spine), and 2) a problem with identifying the cricothyroid membrane (CTM), which is more common in children under the age of 8, females, when the neck is too thin or too thick, and when there is accompanying neck pathology (inflammation, induration, radiation, tumor, goiter)[18].

"Inadequate patient ventilation occurs if any of the following indicators are present: absence or inadequate presence of carbon dioxide (on capnography), absence or inadequacy of chest movement, absence or inadequacy of respiratory sounds, auscultatory signs of severe obstruction, cyanosis, presence of air in the stomach or gastric dilation, decreased oxygen saturation of hemoglobin, absence or inadequate airflow measured by spirometry, anatomical deformities in the lung area detected by lung ultrasound examination, presence of hemodynamic changes associated with hypoxemia and hypercapnia such as hypertension, cardiac rhythm disturbances (tachycardia, bradycardia, and others), as well as additional clinical symptoms that may include changes in mental state or somnolence." This definition aims to be comprehensive and cover (almost) all reasons for inadequate ventilation. However, it does not fundamentally explain what inadequate ventilation is. The definition that most commonly appears in the scientific literature is simpler and states: "Clinically adequate ventilation is the ability to insufflate ≥ 7 mL/kg of air, and anything less than that is inadequate." Additionally, for different means of ventilation, additional parameters are provided - for example, with the laryngeal mask, the air leak pressure should not exceed 15-20 cm $H_2O$[19].

## Preparation for establishing an airway

Regarding the preparation for establishing an airway, the new ASA guidelines suggest the following steps: 1) assess the risk of difficult airway and aspiration using standard (bedside) and advanced methods, and perform an additional evaluation as needed (bedside endoscopy, virtual laryngoscopy/bronchoscopy, three-dimensional printing, ultrasound); 2) check the airway equipment for functionality and availability; 3) have experienced personnel available to assist if needed; 4) inform the patient of the risks if it is known or suspected that establishing an airway will be difficult; 5) preoxygenation and providing continuous oxygenation before and during attempts to resolve difficult airway; 6) ensure adequate patient positioning, and 7) follow an algorithm[5]. If we look at the DAS recommendations[10], we will notice that they are almost identical, meaning that ASA has not offered anything new that we did not already know and apply.

Regarding risk assessment, what may distinguish the new ASA guidelines from recommendations of other associations is that they offer some more sophisticated and technologically advanced methods for identifying high-risk patients, such as computer-generated three-dimensional (3D) stereolithographic models of the trachea[20]. Additionally, under the additional evaluation of the airway, the new guidelines strongly affirm transnasal endoscopy, which allows for the determination of the endoscopic score (the so-called endoscore)[21]. The endoscore describes the visualization of the glottis (during endoscopy) and essentially does not offer anything new, i.e. it represents a slight modification of the Cormack-Lehane grading system (the description of glottis visualization during direct or indirect laryngoscopy), which has been known since 1984[22]. It is a five-step scoring system of laryngeal view, categorized as follows: a full view of the vocal cords, including the anterior commissure (grade 1), partial visualization of the vocal cords, without visualization of the anterior commissure (grade 2a), partial visualization of the vocal cords, where the anterior two-thirds of the cords are not visible, only the vocal processes of the arytenoid cartilages (grade 2b), no visible cords, only epiglottis (grade 3), and no visible cords or epiglottis, only the base of the tongue (grade 4). In the Cormack-Lehane grading system, grade 3 is divided into 3a (complete visualization of the epiglottis) and 3b (partial visualization of the epiglottis), which is practically the only difference between these two scores[21, 22]. What is new (and good) compared to previous

and other guidelines is that special attention is paid to the assessment of the risk of aspiration during risk assessment.

When it comes to equipment for establishing airway and breathing, the new ASA guidelines provide specific recommendations for equipment in the operating room (or other locations where anesthesia is performed) and recommendations for portable equipment (in emergency departments, during transport, and in the field). In the operating room, it is desirable to have the following equipment available: self-inflating bags and face masks, laryngoscopes and various types of blades, auxiliary devices (introducers, bougies, stylets), oropharyngeal and nasopharyngeal airways, endotracheal tubes, and various types of laryngeal masks, suction catheters, oxygen masks and nasal catheters for $O_2$ (all in different sizes), as well as: standard EKG monitoring and capnography, drugs for anesthesia and resuscitation, equipment for emergency invasive access to the trachea, video laryngoscopes (and corresponding stylets). Portable equipment for difficult airway management includes: 1) equipment for alternative ventilation (oral and nasal airways, nasal cannulas, supraglottic airway devices); 2) equipment for alternative intubation (tubes of different sizes, including a micro-laryngeal tube, introducers, intubation SAD, video laryngoscope with appropriate stylet, flexible intubation bronchoscope, intubation video-stylet); 3) equipment for invasive airway management (and for jet ventilation), and 4) other equipment (replacement catheters of different sizes, end-tidal $CO_2$ detectors, versions of locally accepted algorithms for airway management). The proposed equipment does not differ significantly from the recommendations of other associations[23, 24].

Preoxygenation (which involves breathing 100% oxygen for 3-5 minutes before tracheal intubation) and ensuring continuous oxygenation during the establishment of the airway is something that is heavily emphasized in the new ASA guidelines, as it allows for a safe apneic period during the placement of an endotracheal tube or supraglottic airway devices. Truth be told, this is a basic fact that is known to all physicians, so it is not necessary to recommend something that is common knowledge. However, the fact is that sometimes physicians, in their eagerness to establish the airway as quickly as possible (which is not always easy), forget that it is necessary to ventilate and oxygenate the patient between each attempt to place the tube/LMA (and it is desirable to do so during the attempt as well), either using a face mask or one of the apneic oxygenation methods. In this regard, the new ASA guidelines propose and promote a relatively new method of apneic oxygenation, the Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE) method, which was introduced by Patel and first published in 2015[25]. THRIVE is a method of transnasal humidified oxygen insufflation with high flow rates. In his study (on 25 patients), Patel showed that a 10-minute application of oxygen administered in this way (at a flow rate of 70 L/min) allows for a safe apneic period lasting up to 14 minutes, with no patient experiencing desaturation below 90%[25]. Subsequent studies by other authors have shown that higher flow rates (and for longer periods) can be used and that safe apnea can last significantly longer (15-30 minutes in children, 45-60 minutes in adults)[26]. This method has found particular application in otolaryngology, during the extraction of foreign bodies from the airway using rigid bronchoscopy.

## Strategies and algorithms for difficult airway management

Recommended strategies for managing a difficult airway differ depending on whether the difficult airway is anticipated (expected) or not[27]. Strategies also depend on the following assessments: 1) assessed that the patient can be adequately ventilated but difficult to intubate; 2) assessed that the patient cannot be easily ventilated or intubated and 3) assessed that urgent invasive airway management will be difficult. Risk assessment is performed using standard "bedside tests"[28, 29], and if necessary, the aforementioned additional diagnostic methods.

If it is certain (or suspected) that the airway will be difficult, it is necessary to: ensure that an experienced person who can help with airway management is present (or immediately available), inform the patient (or responsible person) that there is a specific (high) risk and which procedures will be used to manage the difficult airway, appropriately position the patient, administer oxygen before starting airway management, and continue oxygen delivery throughout the entire airway management process, including extubation[5].

Tracheal intubation can be performed while the patient is awake, under anesthesia, or a combination of both methods. Intubation of an awake patient is recommended in cases where there is a high risk of difficult mask ventilation, difficult laryngoscopy, difficult intubation, aspiration, and sudden desaturation. However, the decision to intubate an awake patient can also be made based on the presence of only one of these five risks, if it is very high[11, 30]. Anesthesia can be used when managing an anticipated difficult airway if mask ventilation is satisfactory. However, the use of muscle relaxants (MR) to facilitate intubation remains a major dilemma, as there is not enough evidence in the literature about the benefits of using muscle relaxants. Therefore, the decision about managing a difficult airway is left to the discretion of the physician according to the new ASA guidelines.

Assisted maneuvers during tracheal intubation are also recommended in these guidelines, although there is not only a lack of solid evidence that the use of these maneuvers is beneficial, some studies also highlight the harm of their use[31]. Most studies have not confirmed the benefit of Sellick's maneuver (pressure on the cricoid cartilage during intubation) in preventing aspiration. However, it appears that preference is given to the BURP maneuver (Backward, Upward, Right, Pressure) in facilitating glottis visualization

and intubation, which involves pressure in the area below the thyroid cartilage, directed backward, to the right, and upward[19].

What distinguishes the new ASA guidelines[5] from the previous ones (2013)[12] is that the number of intubation attempts is limited to 3 + 1, which is also not different from the DAS recommendations from 2015[10]. Therefore, the new algorithms show that only three intubation attempts are allowed for the physician who initiated the establishment of the airway, after which it is mandatory to call for assistance from a more experienced physician who can make one more attempt to intubate the trachea, and then move on to the next steps of the algorithm. There is a small (but significant) difference compared to the DAS guidelines, which provide for calling in another person for assistance, who do not necessarily have to be older or more experienced than the person who failed to intubate the patient. It seems that the DAS recommendation is better than ASA because sometimes a younger (less experienced) physician can help, i.e. provide successful airway management better than an experienced physician who may be indisposed at that time.

If the patient cannot be intubated after 3 + 1 attempts, placement of a supraglottic device can be attempted, and the number of attempts is also limited to 3 + 1. There is also a great similarity with the DAS algorithms regarding the use of supraglottic devices. Newer generation SADs (at least second generation) are preferred. Considering the numerous advantages of supraglottic devices over tracheal intubation, they are increasingly used as the primary choice for general endotracheal anesthesia, as well as for emergency management of difficult airways[30]. It is assumed (and insisted upon) that oxygen is continuously delivered to the patient (using a mask or other means) throughout the attempts. New ASA guidelines recommend a combination of techniques: direct or video laryngoscopy in combination with or without optical/video stylets, flexible intubation devices, replacement (exchange) catheters, retrograde guide wire placement, or placement of a supraglottic device, as well as supraglottic devices in combination with optical/video stylets or flexible intubation devices (with or without a guide).

If all techniques are exhausted, attempts to establish an airway are unsuccessful, and there is no possibility of establishing spontaneous ventilation with unsatisfactory oxygenation, help is called and the most critical situation is declared: inability to intubate with the simultaneous inability to oxygenate (Can not Intubate, Can not Oxygenate, CICO)[9, 32]. At this point, emergency invasive airway management is initiated, which is the last, fourth step in all algorithms, including this one (plan D). The most common method performed is a cricothyroidotomy, as it is the simplest invasive method (performed in three steps: identification of the cricothyroid membrane, incision and dilation of the membrane, and insertion of a cannula), and also the fastest method (can be performed in less than a minute). If this is not possible, then a surgical tracheotomy or extracorporeal membrane oxygenation (ECMO) is performed as another option (in tertiary healthcare facilities)[9, 33]. Finally, the ASA provides recommendations for further monitoring and treatment (follow-up care) of patients with difficult airways in their new guidelines: corticosteroids should be used as necessary, inform the patient about the difficult airway, document the presence and nature of the difficult airway (to facilitate future procedures), and instruct the patient to record this information, so that it can be useful in potential future emergencies.

## Conclusion

The new ASA recommendations provide a better definition of difficult airway and difficult tracheal intubation compared to previous ones. They provide comprehensive, although not unfamiliar, suggestions regarding the necessary equipment for establishing an airway and assessing the risk of a difficult airway, emphasizing the importance of aspiration risk and the risk of sudden desaturation. Regarding strategies for managing a problematic airway, the new recommendations emphasize the importance of continuous oxygen delivery during the process of managing a difficult airway, including apneic oxygenation. The major innovation in these guidelines compared to the previous ones is the limitation of the number of intubation attempts by one physician to three, which is incorporated into the new algorithms. These recommendations, made by experts from more than 15 associations from different countries, based on a thorough review of contemporary literature, could be a good basis for creating customized national guidelines that would help doctors in this difficult clinical situation and improve treatment outcomes.

# Literature


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