

Failed tracheal intubation in primary health care



Authors:

Indiran Govender¹
Doudou K. Nzaumvila²
Olga M. Maphasha³

Affiliations:

¹Department Family Medicine and Primary Health Care, Faculty of Health Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa

²Department Family Medicine, Faculty of Health Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa

³Department of Family Medicine, Faculty of Medicine, University of Pretoria, Pretoria, South Africa

Corresponding author:

Indiran Govender,
indiran.govender@gmail.com

Dates:

Received: 15 Mar. 2022
Accepted: 29 July 2022
Published: 24 Oct. 2022

How to cite this article:

Govender I, Nzaumvila DK, Maphasha OM. Failed tracheal intubation in primary health care. *S Afr Fam Pract.* 2022;64(1), a5532. <https://doi.org/10.4102/safp.v64i1.5532>

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Tracheal intubation in primary health care is a necessary skill and usually one that is necessary for appropriate emergency management of unstable patients. Primary care practitioners may not have an anaesthetist or critical care doctor available to help them in these emergencies and must manage these patients themselves. Often tracheal intubation may fail because of multiple possible factors and a different course of action may be needed to minimise the potential for harm to the patient. The primary care professional or family physician will have to manage this failed intubation. Primary health care facilities providing obstetric services must have guidelines and appropriate equipment for management of airway problems. This article will explore reasons for the failure of tracheal intubation and how this can be managed.

Keywords: failed intubation; anaesthesia; airway management; primary health care; Mallampati classification; video laryngoscope; hypoxia; hypotension.

Introduction

Failure to achieve a successful tracheal intubation in a maximum of three attempts, regardless of the techniques used, is defined as failed tracheal intubation.¹ Firstly, one would like to note the difference between difficult intubation and, secondly, the new concept of physiological failed intubation. Tracheal intubation is considered difficult if more than one attempt at optimised laryngoscopy and tracheal tube passage is made, a more experienced healthcare worker is required or a change in technique and/or device is made.¹ Most recently, the American Society of Anaesthesiologists Practice Guidelines for Management of the Difficult Airway defined both difficult and failed tracheal intubation as a tracheal intubation that necessitates multiple attempts or tracheal intubation that fails after multiple attempts.² This concept mainly emphasises the anatomical difficulties of visualising the glottic opening or inserting the tracheal tube through the vocal cords.^{3,4} However, in a very ill patient (or even in healthy patients), physiological changes prior to intubation may compromise the gas exchange after the endotracheal tube is placed; this constitutes a physiological failed intubation.^{3,4}

Most tracheal intubations are indicated for airway protection during surgical procedures or airway protection for trauma patients rather than respiratory failure.⁵ In primary health settings, patients requiring tracheal intubations are those who are in need of general anaesthesia (GA) for obstetrics and gynaecology (laparotomy for ectopic pregnancy, sometimes C-section) for trauma and general surgery. Data from an obstetrics article revealed that although the number of deaths related to failed tracheal intubation has lessened considerably over the last three decades, the incidence of failed intubation has stayed roughly steady at between 1:224 and 1:300.⁶ According to the data, not all occurrences seem to be predictable, nor are they all preventable.⁷ However, as failed intubation is an emergency and difficult airways are anticipated, early recognition followed by adequate management as soon as humanly possible are paramount to avoid complications, because airway management-related morbidity is still being reported in closed legal claims.^{8,9}

Junior doctors or doctors with limited anaesthetic training and experience are responsible for providing obstetric anaesthesia in the district hospitals.¹⁰ Even though tracheal intubation is a core skill for medical interns, training is provided for two months that leads to the lack of this essential skill when they are community service doctors working in district hospitals.¹⁰

According to the report from a survey conducted in the United Kingdom in 1995, a supraglottic device laryngeal mask airway was used by 72% of anaesthetists in obstetric anaesthesia to maintain oxygenation when tracheal intubation and face-mask ventilation failed.^{7,11} The choice of a supraglottic device to use for airway rescue management will be determined by the clinical situation, device availability and the clinician's experience.¹²

Factors associated with failed tracheal intubation

Considering factors associated with failed intubation in primary health care, one should differentiate factors related to the general population and those related to obstetric population. In the general population, the age group of 40–59 years and body mass index (BMI) > 30 kg/m² were reported to be associated with failed intubation,⁷ whereas in the obstetric population, factors reported were demographics of the obstetric patients (obesity, maternal age and pre-existing maternal morbidity) and anaesthetic factors. The most common type of anaesthesia for a C-section is spinal anaesthesia, and most clinicians do not have the ability to give GA and protect the airway when spinal anaesthesia fails.^{10,11} For some specific conditions and spinal failure, obstetric GA is recommended.

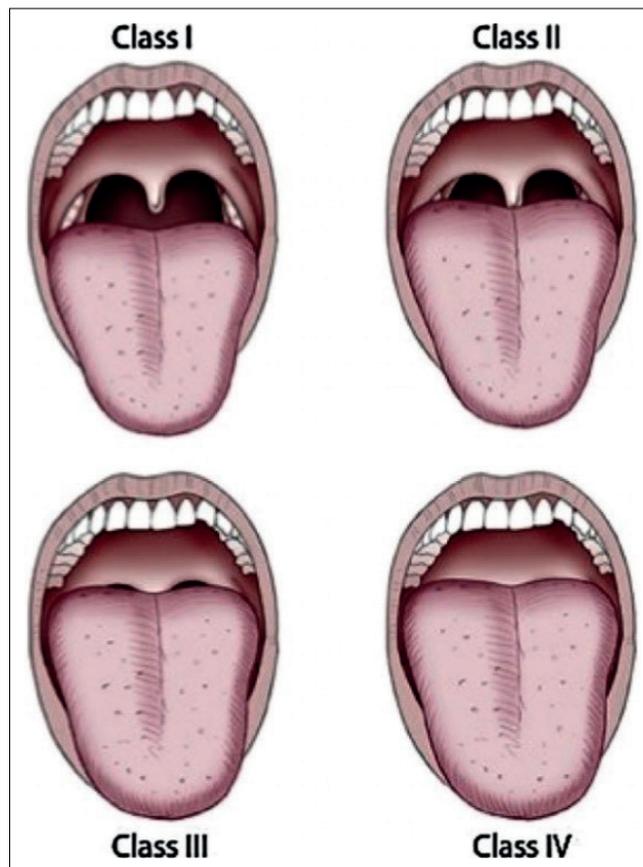
Video laryngoscopy has been shown to lower the incidence of failed intubation by providing a better view of the glottis, but it is not readily available in primary care settings.^{6,13} Video laryngoscopes provide a better view of the glottis; while failure to intubate in general has been documented to occur primarily in planned operations,⁷ some evidence suggests that failed intubations in obstetric patients occur in emergencies and after normal working hours, with the rationale being that airway assessment could not be performed.¹⁴ Mucosal airways easily get more vascular and oedematous as a result of pregnancy-related venous congestion, which can be exacerbated by eclampsia, intravenous fluids and oxytocin given during labour and sometimes Valsalva movements or pushing attempts. Changes in the mucosa results in increasing Mallampati's score as pregnancy progresses (Figure 1¹⁵).¹⁶ Classification includes four grades (1, 2, 3 and 4) depending on visibility of the soft palate, thereby increasing the incidence of failed intubation in obstetrics.¹⁷ Other predictors of difficult intubation can be assessed using the 'look – evaluate – Mallampati – obstruction – neck mobility' (LEMON) classification.¹⁸

It is also worth noting that women about to give birth have a lower functional residual capacity, reduced cardiac tone, as well as slowed stomach emptying caused by labour pain and opioid treatment, all of which put together have a contributing effect on failed intubation.⁶ Increased gastric insufflation, trauma to the posterior pharynx, increased blood and secretions in the airway and oedema to the subglottic structures result from failed intubation, thereby making subsequent intubation more difficult.¹⁹

Besides anatomical changes mentioned here, there are some physiological changes that can lead to failure of optimised gas exchange after intubation.^{3,4}

Hypoxia

Critically ill patients suffering from hypoxemic respiratory failure and obese patients are reported more likely to experience rapid desaturation during intubation, which can lead to haemodynamic instability, hypoxic brain injury and potentially cardiopulmonary arrest. Two different types of hypoxia have



Source: Adapted from Islam S, Selbong U, Taylor CJ, Ormiston IW. Does a patient's Mallampati score predict outcome after maxillomandibular advancement for obstructive sleep apnoea? *Br J Oral Maxillofac Surg*. 2015 Jan;53(1):23–7. <https://doi.org/10.1016/j.bjoms.2014.09.003>

FIGURE 1: Mallampati classification: Class I: fully visible uvula and soft palate; Class II: hard and soft palate and upper portion of uvula are visible; Class III: soft and hard palate and base of uvula are visible; Class IV: only hard palate visible.

been identified. Hypoxic hypoxia or hypoxemic respiratory failure (type I) caused by any etiopathogenesis that adversely affects optimal alveolar-capillary gas exchange (pneumonia, acute respiratory distress syndrome and cardiogenic or noncardiogenic pulmonary oedema) and hypemic hypoxia or hypercapnic respiratory failure (type II), caused by significantly reduced alveolar ventilation or an increase in dead space. However, apart from assessing predicted anatomic difficulties, identifying patients at risk for desaturation during intubation and maximising safe apnoea time by adequate and adapted preoxygenation should be the objective.^{3,4}

Hypotension

Post-intubation hypotension (PIH) is defined as a decrease in systolic blood pressure (SBP) to ≤ 90 mmHg or $\geq 20\%$ from a baseline, a decrease in mean arterial pressure (MAB) to ≤ 65 mmHg or the initiation of vasopressors within the 30 min following intubation.²⁰ It affects up to 25% of emergency department (ED) intubations, which are associated with high mortality and prolonged intensive care unit (ICU) care.²⁰ According to current evidence, shock index of $\geq 80\%$ (heart rate/SBP) is the best predictor of PIH (sensitivity of 67% and specificity of 80%) as compared with other predictors found in literature such as age, acute respiratory failure and chronic renal failure.²⁰

Severe metabolic acidosis

A critically ill patient with severe metabolic acidosis compensates by increasing minute ventilation. The so-called safe apnoeic period during intubation may be harmful, even if brief, as it can result in decrease of pH and a high risk of haemodynamic worsening after intubation.³

Right ventricular failure

Any patient with right ventricular failure (RVF) is at risk of cardiorespiratory collapse post-intubation. Some conditions increase the burden of the right ventricle, such as chronic pulmonary hypertension from lung or left ventricular disease, pulmonary arterial hypertension or acute pulmonary embolism. When invasive mechanical ventilation is added to the decreased preload and increased right ventricular afterload, cardiac arrest is likely common.³

Management of failed intubation in primary care

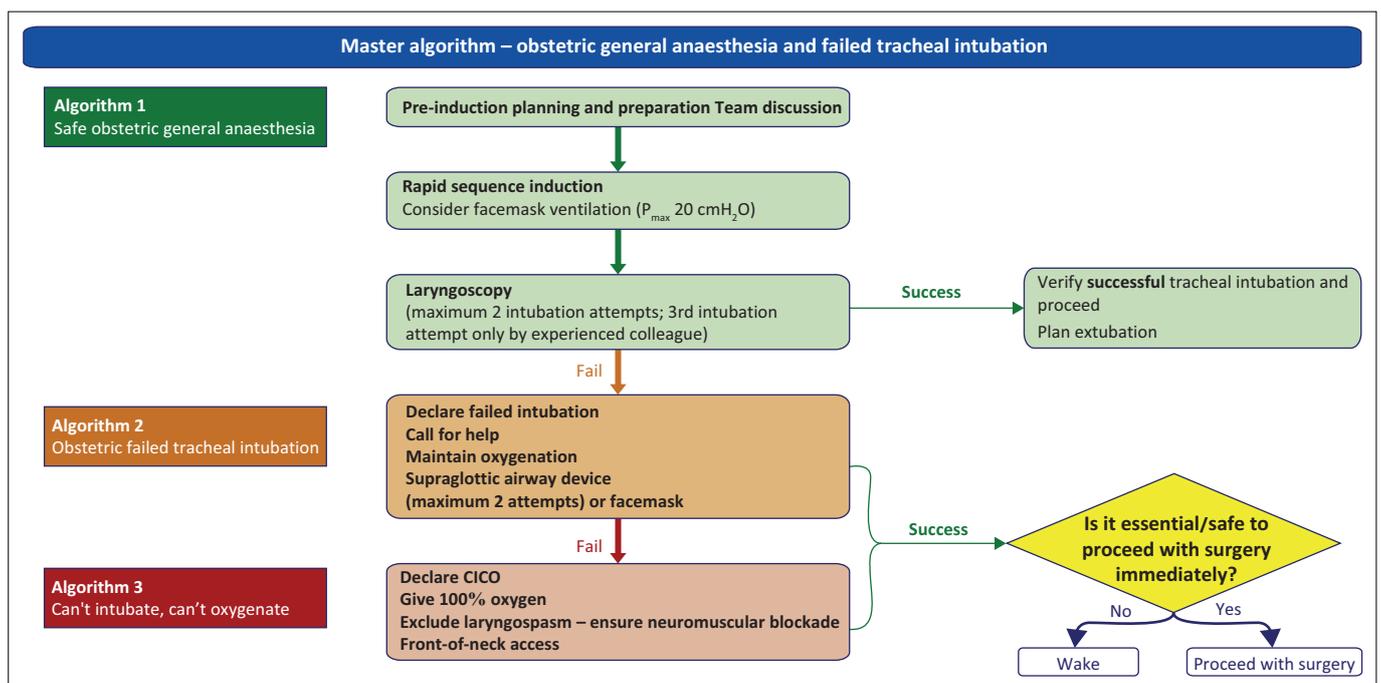
The first step in the management of a difficult airway is identification. It is vital that a call for help should be made immediately if a difficult airway is identified (Figure 2 and Figure 3)^{6,18} with a clear procedure of how to contact a senior personnel and referral route.^{1,6,12} Follow guidelines, for example, Difficult Airway Society guidelines to assist in decision-making during an emergency, as they include steps to assist the team in making the correct decisions, limiting number of airway intervention attempts, encouraging declaration of failure by placing a supraglottic airway device

even when face-mask ventilation is possible and explicitly recommending a time to stop and think about how to proceed (Figure 3).^{1,6,12} The focus is to maintain oxygenation and prevent possible aspiration and awareness.^{5,12}

As soon as correct tracheal tube placement cannot be confirmed after two attempts and a third attempt by an experienced practitioner, failed intubation should be declared.^{6,12} The use of a tracheal tube introducer has been extensively studied as an adjunct to direct laryngoscopy (DL). For tracheal intubation, a malleable stylet and bougie should be placed in the endotracheal tubes for all obstetric intubations.^{12,16} External laryngeal pressure should be applied if poor view with proper positioning of the patient is obtained during attempted DL (Figure 3).^{1,12} View can be improved by applying external laryngeal manipulation. Use the anaesthetist's right hand or backward, upward and rightward pressure (BURP) on the thyroid cartilage.¹² Tracheal intubation cannot be confirmed if correct placement of the tube between vocal cords was not visualised, with no bilateral chest expansion and absence of exhaled carbon dioxide (CO₂) on capnography.¹²

Once failed intubation has been confirmed, use an oropharyngeal airway, four-handed facemask technique and the 'sniffing' position to optimise ventilation, reducing or removing cricoid pressure.^{6,12,21} Supraglottic airway devices (SADs) may be used as an option to facemask ventilation (Figure 3).^{12,15,22}

Supraglottic airway devices are positioned outside of the larynx. They are less invasive tools used for airway management in anaesthesia.²² Since the late 1990s, there has



Source: Adapted from Kollmeier BR, Boyette LC, Beecham GB, et al. Difficult airway. In: StatPearls [homepage on the Internet]. Treasure Island, FL: StatPearls Publishing; 2022 [updated 2021 Oct 27; cited]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK470224/>

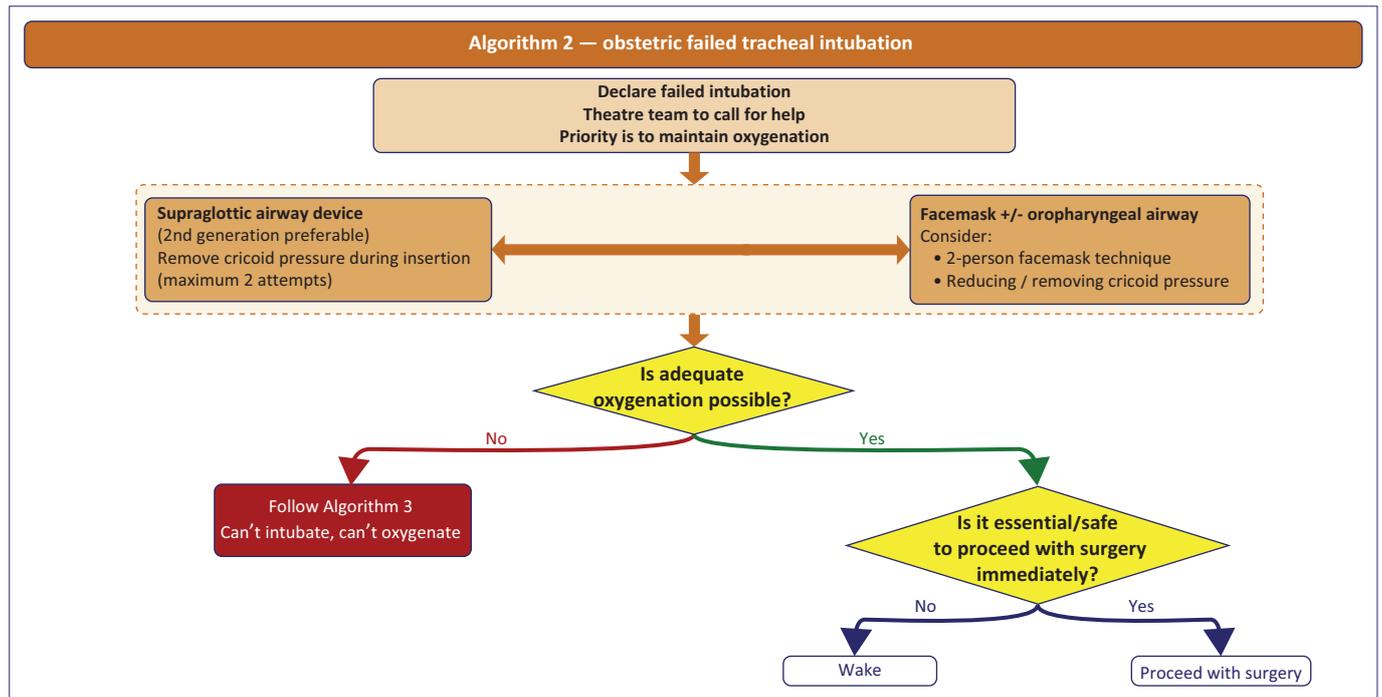
CICO, cannot intubate, cannot oxygenate.

FIGURE 2: Obstetric general anaesthesia and failed tracheal intubation.

been a gradual increase in the use of SAD to continue anaesthesia when failed intubation is declared.^{16,22} Supraglottic airway devices are commonly classified into first-generation devices, containing only a breathing lumen (Figure 4^{6,16}), and second-generation SADs (Figure 5²³), which possess an additional channel for drainage of gastric contents.^{12,22} Second-generation devices are recommended as better rescue devices after failed tracheal intubation, even though they do not provide complete protection against aspiration (Figure 5).⁶ These devices have features such as

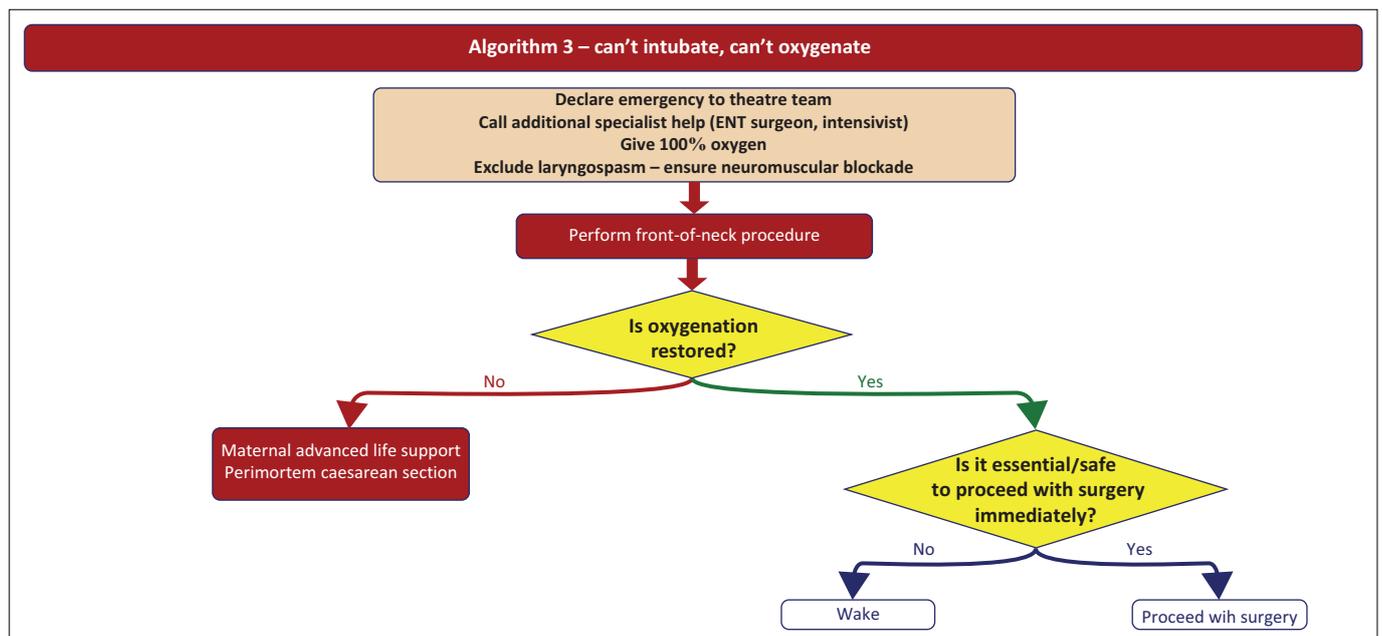
drain tubes or compartments for mitigating risk of aspiration to manage regurgitated content,²² and they also provide a better airway seal for positive pressure ventilation.¹⁵

Supraglottic airway device placement requires less expertise and time for insertion and is associated with fewer complications, as compared with tracheal tube insertion.^{12,22} It is recommended that all clinicians in a position to give anaesthesia should be trained to use and have access to second-generation SADs.¹²



Source: Adapted from Obstetric Anaesthetists Association and Difficult Airway Society. Available from <https://ars.els-cdn.com/content/image/1-s2.0-S1472029919301602-gr3.jpg>

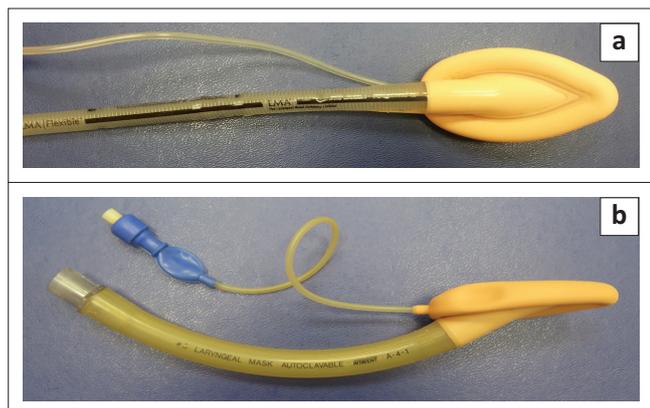
FIGURE 3: Obstetric failed tracheal intubation.



Source: Please see the full reference list of the article, Clayton R, Devlin M. Failed intubation in obstetrics. *Anaesth Intensive Care Med.* 2016;17(8):357 -364. <https://doi.org/10.1016/j.mpaic.2016.05.013>, for more information

ENT, ear, nose and throat.

FIGURE 4: 'Can't intubate, can't oxygenate'.



Source: Michalek P, Donaldson W, Vobrubova E, et al. Complications associated with the use of supraglottic airway devices in perioperative medicine. *BioMed Res Int.* 2015;2015:746560. <https://doi.org/10.1155/2015/746560>

FIGURE 5: Laryngeal mask airway devices (first generation).

Supraglottic airway devices such as laryngeal mask airway devices can be successfully placed on the first attempt (Figure 2).^{6,23} Even though application of cricoid pressure is controversial, it is used in obstetric anaesthesia for the purpose of reducing regurgitation risk.¹ It must be released during the insertion of (preferably) a second-generation SAD with a gastric drain.³ Repeated insertion attempts increase the likelihood of airway trauma and may delay the decision to accept failure to move on to an alternative technique so that oxygenation is maintained.^{6,23} It is crucial that the practitioner is familiar with their use.⁶

Difficult face mask ventilation of the unconscious or induced patient before or between tracheal intubation attempts should be addressed with an appropriate response, including placement of an appropriately sized oropharyngeal and nasopharyngeal airway, use of a two-handed mask hold and exaggerated head extension, unless contraindicated.¹⁶ Optimise airway position and attempt airway manoeuvres such as chin lift or jaw thrust if difficulty is encountered.¹² Face mask ventilation may reduce the risk of significant desaturation.⁶ Emergency front of neck access (FONA) can be used if clinical deterioration and worsening saturation happens (Figure 6).¹⁶

Delay in delivery during management of a difficult airway at caesarean section might further potentiate the effects of maternal physiological derangement. The greatest delay in delivery will be incurred if the woman is awakened after failed intubation.¹⁶

A decision needs to be made whether it is safe or necessary to continue with the operation (Figure 6).¹⁶ This decision can be made with the surgeon pre-operatively during preparation, in case there is a failed intubation, following the World Health Organization surgical checklist.^{6,16} It is influenced by factors related to woman, foetus, staff and clinical situation (Figure 7).¹⁶ If the surgery is not urgent, the safest option is to wake the patient up. The following features related to the urgency of the procedure – the condition of the foetus,

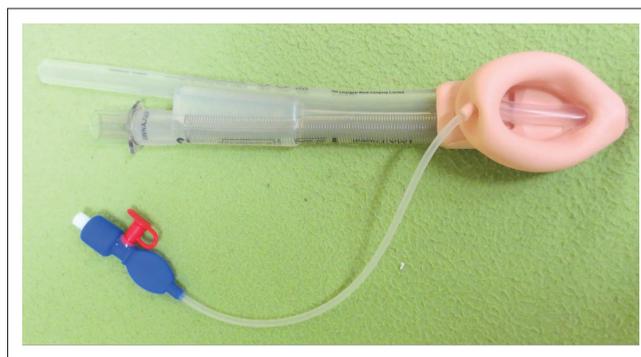


FIGURE 6: ProSeal laryngeal mask airway devices (second generation).

the condition of the mother, anaesthetic experience – must be taken into consideration,¹⁶ not forgetting local practice within the hospital. Oxygenation must be maintained throughout.¹⁵ Proceed with surgery if there is adequate airway or ventilation, and further intubation attempts are discouraged unless a new factor presents that significantly increases the chance of success, or there is an indication for prolonged airway control.¹⁶

When it comes to physiological failed intubation, in the case of a critically hypoxic patient, apnoeic oxygenation should always come just after standard practice of preoxygenation.³ Using a wide-bore nasal cannula, a high-flow nasal cannula or conventional nasal prongs helps to extend the safe apnoeic period.³ Should shunt physiology be caused by atelectasis or alveolar filling from pneumonia, acute respiratory distress syndrome (ARDS) or pulmonary oedema be suspected, nasal intermittent positive pressure ventilation (NIPPV) or supraglottic airways can be used²⁴ with the aid of analgesia, anxiolysis or delayed sequence intubation (DSI) if indicated; however, use of ketamine should be cautious because of the risk of cardiac arrest.³ Tracheal intubation should be delayed in case of hypotension and shock index ≥ 0.8 to give time to aggressive volume resuscitation if the patient is likely to be a volume responder.³ If a patient is unresponsive to volume resuscitation, a norepinephrine infusion should be considered or vasopressor bolus if there is no time for pre-intubation resuscitation. Because many induction drugs have negative haemodynamic effects and some can cause peri-intubation hypotension, one should exercise extreme caution in the product to be used. Etomidate, for example, a nonbenzodiazepine sedative, is basically haemodynamically neutral²⁵ as compared with benzodiazepine agents, which have a sympatholytic effect, or propofol, which causes myocardial depression and a decline in vascular tone.²⁶ Some authors suggested the use of ketamine, considering its sympathomimetic properties, even though there have been reports of cardiac arrest following ketamine administration.²⁷ To prevent physiologically unsuccessful intubation in patients with severe metabolic acidosis, other forms of support, such as NIPPV, should be used to try to correct the acidosis first. Even after intubation, the

Factors to consider		Wake		Proceed	
Before induction	Maternal condition	• No compromise	• Mild acute compromise	• Haemorrhage responsive to resuscitation	• Hypovolaemia requiring corrective surgery • Critical cardiac or respiratory compromise, cardiac arrest
	Fetal condition	• No compromise	• Compromise corrected with intrauterine resuscitation, pH < 7.2 but > 7.15	• Continuing fetal heart rate abnormality despite intrauterine resuscitation, pH < 7.15	• Sustained bradycardia • Fetal haemorrhage • Suspected uterine rupture
	Anaesthetist	• Novice	• Junior trainee	• Senior trainee	• Consultant/specialist
	Obesity	• Supermorbid	• Morbid	• Obese	• Normal
	Surgical factors	• Complex surgery or major haemorrhage anticipated	• Multiple uterine scars • Some surgical difficulties expected	• Single uterine scar	• No risk factors
	Aspiration risk	• Recent food	• No recent food • In labour • Opioids given • Antacids not given	• No recent food • In labour • Opioids not given • Antacids given	• Fasted • Not in labour • Antacids given
	Alternative anaesthesia • regional • securing airway awake	• No anticipated difficulty	• Predicted difficulty	• Relatively contraindicated	• Absolutely contraindicated or has failed • Surgery started
After failed intubation	Airway device/ventilation	• Difficult facemask ventilation • Front-of-neck	• Adequate facemask ventilation	• First generation supraglottic airway device	• Second generation supraglottic airway device
	Airway hazards	• Laryngeal oedema • Stridor	• Bleeding • Trauma	• Secretions	• None evident

Source: Mushambi MC, Kinsella SM, Popat M, et al. Obstetric Anaesthetists' Association and difficult airway society guidelines for the management of difficult and failed tracheal intubation in obstetrics. *Anaesthesia*. 2015;70(11):1286–1306. <https://doi.org/10.1111/anae.13260>

FIGURE 7: Wake or proceed with surgery, factors to consider.

patient should be allowed to maintain their own high minute ventilation.³

Conclusion

The most common complication of anaesthesia in primary health settings is failed intubation. Early identification and management are crucial in managing all patients from EDs and theatres. Video laryngoscopy and SADs are useful tools to have during management of difficult and failed intubation, only if the primary health care practitioner is familiar with them. Most primary health care setting theatres do not have access to video laryngoscopy. It is important for the theatre team to follow local guidelines when faced with difficult intubation.

Acknowledgements

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

I.G., D.K.N. and O.M.M. contributed equally to this work.

Ethical considerations

This article followed all ethical standards of research without direct contact with human or animal subjects.

Funding information

This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Data availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

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