Update in
Anaesthesia

Obstetric airway management

L Bordoni,[1] K Parsons,[2] and MWM Rucklidge[3*]
*Correspondence email: Matthew.rucklidge@health.wa.gov.au
doi: 10.1029/WFSA-D-18-00019

Abstract

Obstetric airway management has long been associated with an increased risk of failed tracheal intubation and airway-related morbidity and mortality. However, there is little evidence that failed intubation rates have fallen despite recent advances in airway equipment and techniques. Airway difficulties may be encountered due to maternal physiological and anatomical changes associated with pregnancy and the unique situational factors associated with emergency obstetric general anaesthesia in which the wellbeing of both mother and unborn child may be at risk. Recent guidelines have highlighted the importance of maintaining oxygenation following failed intubation and the decision making required to safely manage obstetric airway emergencies. This article reviews the recent literature and describes recommendations for the management of the difficult obstetric airway.

Key words: obstetric anaesthesia; airway management; pre-oxygenation; failed intubation

INTRODUCTION

Obstetric patients are at increased risk of failed intubation due to a number of unique clinical, environmental and human factors. Despite widely publicised 'failed intubation drills' and advances in airway equipment and techniques, the incidence of failed obstetric tracheal intubation has not changed for more than 40 years, and remains higher than in the non-obstetric population.[1] A recent literature review found an incidence of failed tracheal intubation of 2.6 per 1000 obstetric general anaesthetics (1 in 390) and associated maternal mortality of 2.3 per 100 000 general anaesthetics (one death for every ninety failed intubations).[1] Given the difficulties in accurately predicting difficult intubation, and the unchanged rate of failed obstetric tracheal intubation, there has been a shift in focus away from efforts to primarily reduce rates of failed intubation towards a greater appreciation of measures to maintain oxygenation and to control associated human factors that may impact on delivery of safe airway management. These are described in recent UK obstetric-specific airway guidelines jointly published by the Obstetrics Anaesthetists' Association (OAA) and Difficult Airway Society (DAS)[2] and are explored in the following article.

Why is obstetric airway management more difficult?

Anatomical and physiological factors

Maternal anatomical and physiological changes of pregnancy may contribute to the increased failed tracheal intubation rate and airway-related adverse events. (Table 1) Obesity, increased maternal age and associated co-morbidities may further exacerbate the impact of these changes. A 2-year case-control study of failed obstetric intubation found age, body mass index and Mallampati score were significant independent predictors of failed obstetric tracheal intubation.[3]

Situational factors

There is increasing awareness of the contribution of situational and human factors to complications encountered during airway management.[4] Cognitive load may be increased in the obstetric setting by the unique emotional environment and dual demands of managing maternal and fetal wellbeing. The declining frequency of obstetric general anaesthesia (GA) in several parts of the world has led to many anaesthetists having little experience of the technique. Time constraints in the emergency setting may lead to inadequate airway assessment and patient positioning.

[1]Registrar, [3]Consultant
Department of Anaesthesia
Perioperative and
Pain Medicine
King Edward
Memorial Hospital
Perth
WESTERN AUSTRALIA

[2]Consultant
Anaesthetic Department,
Chesterfield Royal Hospital
NHS Foundation Trust
UNITED KINGDOM

Table 1: Pregnancy related maternal anatomical and physiological factors that may contribute to airway difficulties and adverse airway-related events

	Anatomical and physiological changes	Clinical consequences
Airway	• Increased breast size • Weight gain in pregnancy • Increased vascularity and oedema of the airway mucosa	• Difficulty with laryngoscope insertion • Difficulty with positioning and increased oxygen desaturation • Increased risk of airway bleeding and potential difficulty with tracheal intubation
Respiratory	• Reduced functional residual capacity	• Increased oxygen desaturation
Gastrointestinal	• Decreased lower oesophageal sphincter tone • Delayed gastric emptying	• Increased risk of gastric regurgitation and pulmonary aspiration

Knowledge of the increased risk of failed intubation in this patient group may further heighten anxiety, erode confidence and lead to the "self-fulfilling prophecy" of failure to secure the airway.[5]

MANAGEMENT OF THE OBSTETRIC AIRWAY

Planning and preparation for safe obstetric GA

Safe obstetric airway management goes hand-in-hand with many elements of the obstetric GA technique. Important components include: adequate and timely airway assessment, consideration of fasting status, pharmacological aspiration prophylaxis, optimal patient positioning, adequate pre-oxygenation and provision of a secure airway (typically with an endotracheal tube following rapid sequence induction of anaesthesia). Importantly, focus on airway management must continue until the patient has recovered from GA and is able to maintain her own airway. (Figure 1)

Airway assessment

Bedside predictive tests of difficult intubation are notoriously unreliable. However, every woman undergoing obstetric surgery should have an airway assessment, and this should be clearly documented and communicated when necessary.[2] Assessment should not only consider potential difficulties with tracheal intubation but also difficulties with facemask and supraglottic airway device (SAD) ventilation, and front-of-neck access. Several factors have been identified that may predict airway difficulties and these are shown in Table 2.

Pulmonary aspiration risk reduction

Measures to avoid or reduce the harm of pulmonary aspiration of gastric contents are a key component of obstetric GA. Gastric emptying in the non-labouring pregnant women is similar to the non-pregnant patient but is delayed by labour and opioid analgesia.[6] The combination of H_2-receptor antagonist (e.g. ranitidine) and an antacid (e.g. sodium citrate) has been shown to increase gastric acid pH; thereby reducing the potential harm should pulmonary aspiration occur.

More recently, point-of-care ultrasound (US) assessment of gastric content has been described to individualise the risk of regurgitation and tracheal aspiration in non-obstetric and obstetric patients.[7] Further investigation is required to determine its utility in the emergency obstetric patient.

Patient positioning

Optimal patient positioning is essential prior to induction of obstetric GA. A 20-30° head-up position should be considered for obstetric patients.[2] A head-up position may facilitate insertion of the laryngoscope, improve the glottic view, increase functional residual capacity (FRC), and reduce the risk of gastric regurgitation. Aligning the external auditory meatus with the supra-sternal notch may be superior to the typical 'sniffing' position and is particularly helpful in the obese patient. This 'ramped' position can be achieved with the use of specific equipment, (e.g. Oxford HELP Pillow (Alma Medical, London, UK)) or with the use of pillows placed under the patient's shoulders and head.

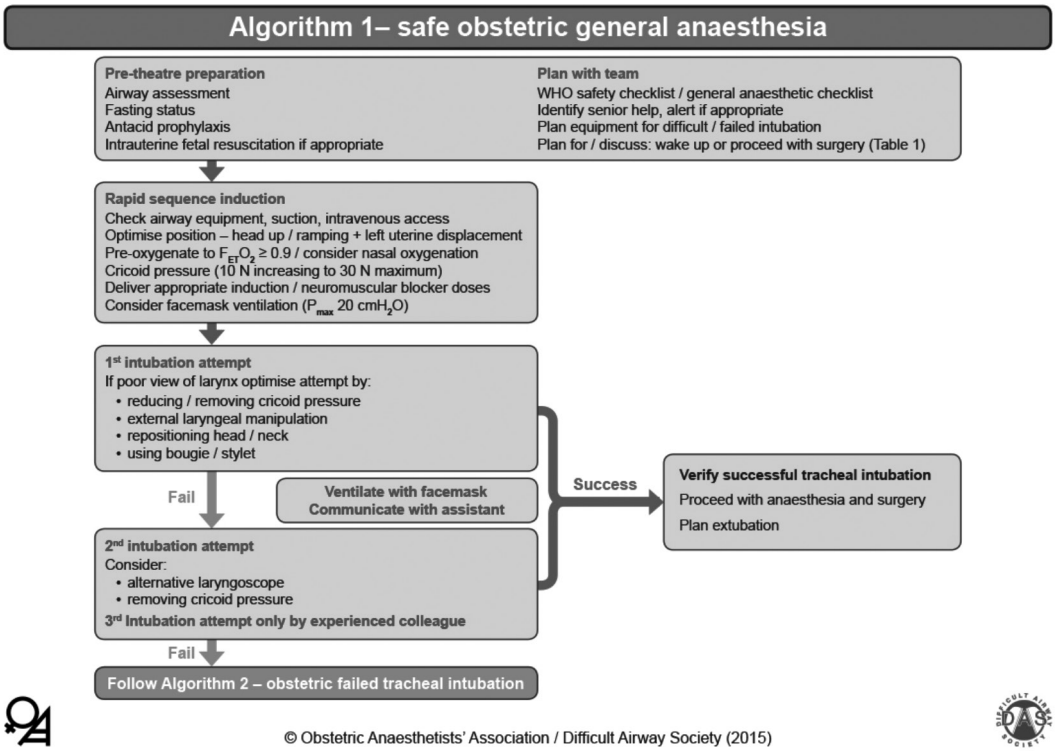
Pre-oxygenation

Effective pre-oxygenation delays desaturation following induction of obstetric GA, especially in the parturient with an already decreased FRC (e.g. obesity). Lung denitrogenation is best indicated by end-tidal oxygen fraction ($FETO_2$), and ensuring a $FETO_2$ of ≥ 0.9 prior to induction is recommended.[2] Fresh gas flows of over $10L.min^{-1}$ and a tight fitting facemask are required for effective pre-oxygenation. Eight deep breaths of 100% oxygen over one minute may be as effective as the more commonly adopted three minutes of normal tidal breathing.

Currently there is interest in alternative techniques to provide pre-oxygenation and/or apnoeic oxygenation during tracheal intubation in both non-obstetric and obstetric patients.[2] Insufflation of oxygen at $5L.min^{-1}$ via nasal cannulae may maintain bulk flow of oxygen during intubation attempts and prolong the apnoeic time. Delivery of high flow humidified nasal oxygen (also referred to as 'transnasal humidified rapid insufflation ventilatory exchange' (THRIVE)) may provide an alternative method of pre-oxygenation and/or apnoeic oxygenation.[8,9] While reports of the effective use of THRIVE in critical care and perioperative settings are increasing, there are few data in the obstetric population. Potential complications, including gastric insufflation and epistaxis, exist in this patient group and further investigation is required before widespread adoption of these techniques into obstetric GA practice.

It is worthwhile palpating and confirming the position of the cricothyroid membrane during pre-oxygenation in the event supraglottic attempts at airway management fail and front-of-neck access is required. More recently, US of the neck has been shown to accurately aid identification of the cricothyroid membrane and this is an emerging skill anaesthesia providers may wish to acquire.[10]

Figure 1: OAA/DAS Algorithm 1 – safe obstetric general anaesthesia. WHO, World Health Organization; F_{ET} O_2, end-tidal fraction of oxygen; P_{max}, maximal inflation pressure. This algorithm is reproduced with permission from the OAA and DAS and is available online in pdf and PowerPoint formats.[2]



Cricoid pressure

The use of cricoid pressure is controversial. The OAA/DAS airway guidelines recommend application of cricoid pressure during rapid sequence induction of obstetric GA.[2] However, due to limited evidence for its effectiveness in decreasing aspiration risk and potential for making airway management more difficult if incorrectly applied, its use has been questioned. Consequently, many guidelines recommend a low threshold to reduce or release cricoid pressure if it impairs the laryngoscopic view and/or insertion of the endotracheal tube, or impedes mask or SAD ventilation.[2] Should a SAD be required after tracheal intubation fails, cricoid pressure should be temporarily released during its insertion.

Facemask ventilation prior to tracheal intubation

Facemask ventilation following induction of obstetric GA has traditionally been avoided because of the fear of gastric insufflation and risk of regurgitation. However, gentle facemask ventilation (maximal inflation pressure <20cmH_2O along with application of cricoid pressure) has been recommended in recent guidelines because it may reduce the risk of oxygen desaturation and provide an indication of ease (or otherwise) of ventilation in the event tracheal intubation fails.[2]

Elective use of SADs for Caesarean Section

Tracheal intubation following rapid sequence induction of GA is generally recommended in the obstetric patient. However, there are a number of reports of the elective use of SADs in fasted women undergoing elective caesarean section. While significant airway-related complications were not found in these studies, higher risk women, including those with obesity, were generally excluded.

Direct and videolaryngoscopy

Direct laryngoscopy using a standard laryngoscope (e.g. Macintosh laryngoscope) is commonly performed. A short-handled laryngoscope should be available for pregnant women because enlarged breasts may impede insertion of a laryngoscope with a standard-length handle.

Over recent years there has been widespread adoption of videolaryngoscopy into many areas of anaesthesia and critical care. Videolaryngoscopy has been shown to improve the glottic view in the non-obstetric population when compared with direct laryngoscopy and a combined videolaryngoscope bougie technique has recently been found to provide a high success rate for tracheal intubation in the emergency out-of-hospital setting.[11] Such is the potential benefit of these devices that there is an argument for their first-line use for all tracheal intubations. Consequently, current guidelines recommend a videolaryngoscope should be immediately available for all obstetric GAs.[2] Videolaryngoscopy has the additional advantage of enabling the view to be observed by the anaesthetic assistant, improving teamwork and communication and allowing cricoid pressure to be modified if required. However, tracheal intubation may still be difficult despite an adequate glottic view, especially when using a videolaryngoscope with a hyper-angulated blade. Because several

Table 2: Factors that predict problems with tracheal intubation, mask ventilation, insertion of a supraglottic airway device and front-of-neck airway access. This table is reproduced with permission from the OAA and DAS and is available online in pdf and PowerPoint formats.[2]

	Tracheal intubation	Facemask ventilation	SAD insertion	Front-of-neck access
Body mass index >35 kg/m_2	X	X	X	X
Neck circumference >50cm	X	X	X	X
Thyromental distance <6cm	X	X	X	
Cricoid pressure	X	X	X	
Mallampati grade 3-4	X	X		
Fixed cervical spine flexion deformity	X			X
Dentition problems (poor dentition, buck teeth)	X		X	
Misc. (obstructive sleep apnoea, reduced lower jaw protrusion, airway oedema)	X	X		
Mouth opening <4cm	X			

different videolaryngoscopes are currently available, experience with one type does not equate to skill with all, and the optimal device is currently unknown.[12]

MANAGEMENT OF THE ANTICIPATED DIFFICULT AIRWAY

Should potential airway difficulties be identified in the antenatal period, the woman should be referred early for formulation of an airway management plan. The optimal plan will depend on the specific airway-related issue. In some cases, involvement of the obstetric team will be required since plans will be influenced by intended mode of delivery. If a plan is made for a specific airway intervention performed under controlled conditions (e.g. awake fibreoptic intubation (AFOI) prior to elective caesarean section under GA), contingency plans should be considered in the event the woman presents in the after-hours period requiring an emergency intervention.

A detailed discussion of techniques of AFOI in the pregnant woman is beyond the scope of this article, but similar techniques for the non-pregnant woman can generally be used. The oral route for tracheal intubation is recommended in this patient group to reduce the risk of bleeding from trauma to the nasopharynx. Since AFOI is best performed in a controlled environment with a cooperative patient, performing this technique in the often chaotic and stressful setting of an emergency caesarean section is challenging and in such circumstances alternative airway approaches may be safer.[13]

MANAGEMENT OF THE UNANTICIPATED DIFFICULT AIRWAY

Measures to improve the glottic view should be performed if a poor view of the larynx is obtained during the first intubation attempt. These include changing the position of the patient's head and neck, and decreasing, readjusting the direction of, or releasing cricoid pressure. If passage of the endotracheal tube is the issue then use of a bougie or stylet should be considered as well as using an endotracheal tube of smaller diameter. In order to decrease the risk of airway trauma, the most experienced anaesthetist present should carry out the second intubation attempt.

Should the second intubation attempt fail, a 'failed intubation' should be clearly communicated and further help sought.

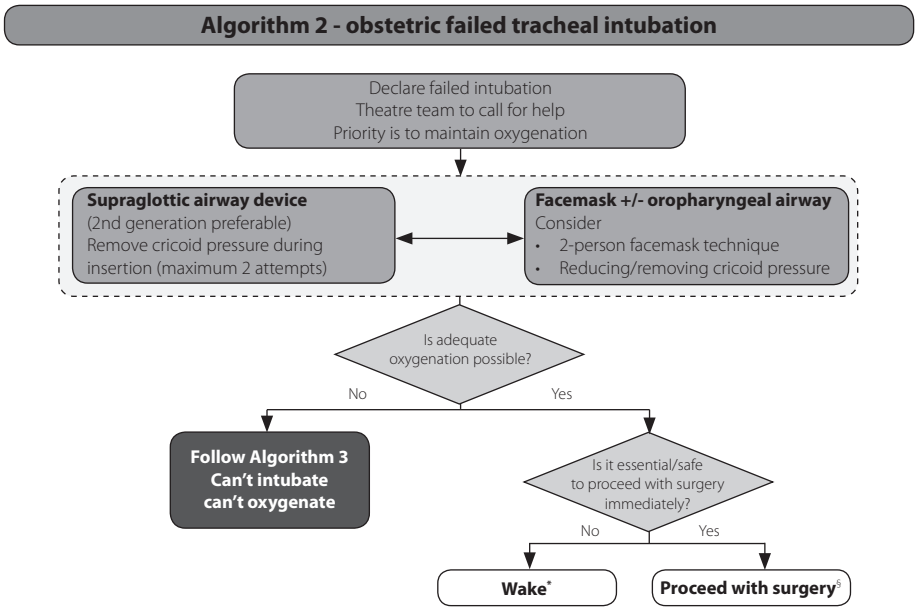
Failed intubation

Following declaration of a failed intubation, oxygenation via a facemask or a SAD should be prioritized with simultaneous consideration of measures to avoid awareness and aspiration, both of which are increased in this patient group. (Figure 2) Effectiveness of facemask ventilation may be improved by insertion of an oropharyngeal airway and using two hands to hold the facemask with a second person squeezing the bag. If facemask ventilation is inadequate, and/or a decision is made to proceed with surgery, then insertion of a SAD is recommended. A second generation SAD is recommended because these devices enable drainage of gastric contents and provide higher inflation pressures.[2] Cricoid pressure should be temporarily released during SAD insertion, which may be facilitated by a laryngoscope. A maximum of two attempts at SAD insertion are recommended to avoid oropharyngeal trauma that may impair subsequent oxygenation of the patient.

Can't Intubate, Can't Oxygenate

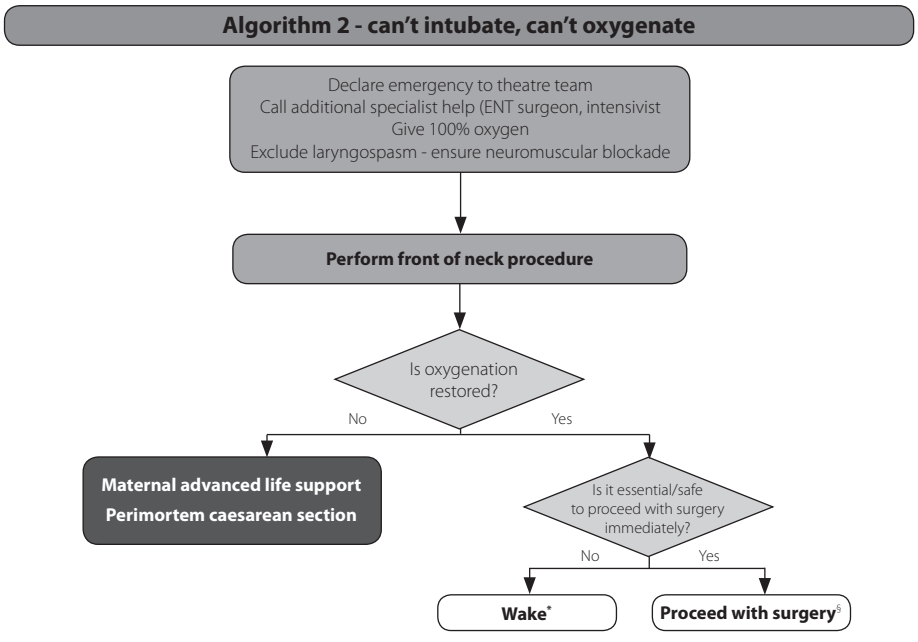
If adequate ventilation and oxygenation cannot be achieved via facemask or SAD, then a 'can't intubate, can't oxygenate' situation should be clearly communicated. (Figure 3) If transitioning to front-of-neck airway access, specialist help should be sought (e.g. laryngologist surgeon and/or intensivists) but their availability should not delay attempts at re-establishing oxygenation. If front-of-neck access is unsuccessful then maternal advanced life support should be instigated and a peri-mortem caesarean section considered if over twenty weeks gestation.

Figure 2: OAA/DAS Algorithm 2 – obstetric failed tracheal intubation. The diamonds represent decision-making steps. This algorithm is reproduced with permission from the OAA and DAS and is available online in pdf and Powerpoint formats.[2]



[1]See Table 1, [§]See Table 2

Figure 3: OAA/DAS Algorithm 3 – ' can't intubate, can't oxygenate'. The diamonds represent decision-making steps. ENT, ear, nose and throat. This algorithm is reproduced with permission from the OAA and DAS and is available online in pdf and PowerPoint formats.[2]



*See Table 1, [§]See Table 2

Front-of-neck access techniques

Emergency front-of-neck access can be achieved via small-bore cannula placement or use of a scalpel but the optimal technique is unclear. The OAA/DAS obstetric airway guidelines recommend following DAS non-obstetric guidance and perform a scalpel cricothyroidotomy because the authors consider this technique to be faster and more reliable in the emergency setting.[2,14] However, other guidelines support the initial use of the cannula cricothyroidotomy technique followed by a scalpel technique should the former fail.[15] While definitive evidence supporting one technique over another is lacking, performing this procedure in the context of an evolving life-threatening emergency is undoubtedly challenging. Suitable equipment should be immediately available and all anaesthetists should be trained in this emergency procedure.

To wake or proceed with surgery

Waking the obstetric patient following failed intubation may not always be the optimal course of action if maternal and/or fetal life is at risk should the operation be abandoned. However, in the elective setting with no risk to either mother or unborn child, waking and subsequently proceeding with an alternative anaesthetic technique may be the correct decision. There are a number of factors that influence this decision and these are shown in Figure 4. Ultimately, the decision will depend on the clinical judgment of the anaesthetist and the evolving situation.[16]

If the decision is made to wake the patient, oxygenation should be prioritised with simultaneous measures taken to decrease aspiration risk (cricoid pressure) and potential awareness (small boluses of IV anaesthetic agent) if there is persisting neuromuscular blockade. Neuromuscular function should be monitored and sugammadex (if available) administered if rocuronium was used at induction. Waking a pregnant woman following failed intubation may not be straightforward and in transitioning from the anaesthetised, paralysed state, there is a risk of airway complications on emergence including laryngospasm and pulmonary aspiration. Whether the patient should be left in the supine position or turned to the lateral head-down position during emergence from GA will depend on several factors including patient weight, ease of maintaining oxygenation and risk of regurgitation. Waking the patient in the supine head-up position may be favourable if the anaesthetist is most familiar with this position and oxygenation has been difficult. Since caesarean section was abandoned, lateral uterine displacement should be maintained throughout.

If the patient is woken, subsequent anaesthetic management will depend on several factors including the urgency of surgery and patient suitability for other anaesthetic techniques including neuraxial block and GA after AFOI. If the decision is made to proceed with AFOI, this will require cooperation from the woman and may need to be delayed until she has recovered from her earlier GA.

If the decision is made to continue with the caesarean section, surgery should be performed by the most senior member of the obstetric team, fundal pressure minimized at delivery to reduce the risk of gastric emptying and/or impairment of ventilation and the neonatal team informed that a failed intubation has occurred. There are several

Figure 4: Wake or proceed with surgery? Criteria to be used in the decision to wake or proceed following failed tracheal intubation (Table 1 from the OAA/DAS Guidelines). This algorithm is reproduced with permission from the OAA and DAS and is available online in pdf and PowerPoint formats.[2]

Table 1 – proceed with surgery?

	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

Criteria to be used in the decision to wake or proceed following failed tracheal intubation. In any individual patient, some factors may suggest waking and others proceeding. The final decision will depend on the anaesthetist's clinical judgement.

factors to consider if proceeding with surgery in the unintubated patient including: whether to use positive pressure or spontaneous ventilation, whether to maintain neuromuscular blockade, whether to maintain cricoid pressure throughout the procedure, whether to continue with the current airway device (facemask or SAD) or attempt to intubate the trachea using the SAD as a conduit, and the ideal agent to maintain anaesthesia. The clinical situation and the individual preferences and skills of the anaesthetist will likely dictate many of these decisions. Airway management may become easier once the woman has been delivered because of the decrease in maternal oxygen consumption and reduced intra-abdominal pressure and subsequent improvement in chest compliance. It is prudent to use a non-irritant volatile agent (e.g. sevoflurane). Whether to attempt tracheal intubation with a fibreoptic scope using the SAD as a conduit, demands careful consideration. The anaesthetist should consider their own skills, availability of suitable equipment and weigh up the benefits of securing the airway with an endotracheal tube with the risk of failure to intubate and potentially worsening the clinical situation.

EXTUBATION AND POSTOPERATIVE CARE

Airway complications occur at extubation and recovery and the anaesthetist should remain vigilant until the patient is awake and able to maintain her own airway. Obstetric patients should be extubated awake in the left lateral or head-up position once neuromuscular blockade has been reversed.

Training

Given the reduced exposure of trainee anaesthetists to obstetric GA in many parts of the world, simulation-based training may aid acquisition and maintenance of skills for difficult obstetric airway management and other high-stakes clinical situations and its adoption into training programs has been advocated. Other novel approaches and visual aids that help clinical teams perform in life-threatening situations have been described. The 'Vortex Approach', designed for use in a developing, time-critical airway emergency, aims to provide a simple and consistent mental model and implementation tool for the real-time management of an airway emergency and may be valuable if faced with an evolving obstetric airway emergency.[17]

CONCLUSION

Obstetric GA is often uneventful but is associated with a higher rate of failed intubation and associated adverse events. Greater focus on oxygenation via alternative airway devices and techniques is recommended along with an appreciation of the situational and human factors that commonly accompany an obstetric airway emergency. Widespread adoption of videolaryngoscopy is likely to reduce rates of failed intubation in this patient group.

REFERENCES

1. Kinsella SM, Winton AL, Mushambi MC, et al. Failed tracheal intubation during obstetric general anaesthesia: a literature review. *Int J Obstet Anesth*. 2015; **24**: 356-74.
2. 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**: 1286-306.
3. Quinn AC, Milne D, Columb M, Gorton H, Knight M. Failed tracheal intubation in obsteric anaesthesia: 2 yr national case-control study in the UK. *Br J Anaesth* 2012: **110**: 74-80.
4. Flin R, Fioratou E, Frerk C, Trotter C, Cook TM. Human factors in the development of complications of airway management: preliminary evaluation of an interview tool. *Anaesthesia*. 2013; **68**: 817-25
5. Russell R. Failed intubation in obstetrics: a self-fulfilling prophecy? *Int J Obstet Anesth*. 2007; **16**: 1-3.
6. O'Sullivan G. Gastric emptying during pregnancy and the puerperium. *Int J Obstet Anesth* 1993; **2**: 216-24.
7. Van de Putte P, Perlas A. Ultrasound assessment of gastric content and volume. *Br J Anaesth* 2014; **113**: 12-22.
8. Mir F, Patel A, Iqbal R, Cecconi M, Nouraei SAR. A randomised controlled trial comparing transnasal humidified rapid insufflation ventilatory exchange (THRIVE) pre-oxygenation with facemask pre-oxygenation in patients undergoing rapid sequence induction of anaesthesia. *Anaesthesia* 2017; **72**: 439-443.
9. Tan PCF, Dennis AT. High flow humidified nasal oxygen in pregnant women. *Anaesth Intensive Care* 2018; **46**: 36-41.
10. Kristensen MS, Teoh WH, Rudolph SS. Ultrasonographic identification of the cricothyroid membrane: best evidence, techniques, and clinical impact. *Br J Anaesth* 2016; **117** (S1): i39-i46.
11. Angerman S, Kirves H, Nurmi J. A before-and-after observational study of a protocol for use of the C-MAC videolaryngoscope with a Frova introducer in pre-hospital rapid sequence intubation. *Anaesthesia*. 2018; **73**: 348-55.
12. Kelly FE, Cook TM. Seeing is believing: getting the best out of videolaryngoscopy. *Br J Anaesth* 2016 suppl 1; **117**: i9-i13.
13. Girard T, Palanisamy A. The obstetric airway: if we can't predict it can we prevent it? *Anaesthesia* 2017; **72**: 143-47.
14. Frerk C, Mitchell VS, McNarry AF, Mendonca C, Bhagrath R, Patel A, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. *Br J Anaesth* 2015; **115**: 827-48.
15. Heard AM, Green RJ, Eakins P. The formulation and introduction of a 'can't intubate, can't ventilate' algorithm into clinical practice. *Anaesthesia* 2009; **64**: 601-8.
16. Rucklidge MW, Yentis SM. Obstetric difficult airway guidelines - decision making in critical situations. *Anaesthesia*. 2015; **70**: 1221-5.
17. Chrimes N. The Vortex: a universal 'high-acuity implementation tool' for emergency airway management. *Br J Anaesth*. 2016; **117** suppl 1: i20-i27.