Simulation Patient Design (June, 2021)
Case of an Unanticipated Difficult Airway on L&D

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Introduction

The unanticipated difficult obstetrical airway is one of the most perilous situations that can arise on Labor and delivery (L&D). As such, identifying patients with potentially difficult airways is important, and conducting a thorough airway examination as part of the preoperative assessment is imperative. Risk factors for difficult facemask ventilation and intubation need to be identified so that the anesthesiologist can have all necessary airway equipment immediately available. There are many independent risk factors for difficult facemask ventilation and intubation, which include: (1) age >55 years, (2) body mass index (BMI) >26, (3) facial hair, (4) edentulous patient, (5) obstructive sleep apnea, (6) history of neck radiation, (7) male sex, and (8) Mallampati class III or IV.[1]

Obstetric patients have an increased risk for airway complications because of the vast changes in physiology and anatomy that occur during pregnancy and labor, which include airway edema, increased oxygen consumption, decreased functional residual capacity, breast enlargement, weight gain, delayed gastric emptying during labor, and decreased lower esophageal sphincter tone.[2] Neuraxial anesthesia is preferred in obstetric patients when there are no contraindications so that airway manipulation can be avoided. Adequate preparation is paramount to securing an airway in a patient with an identified or unidentified difficult airway. Since an obstetric patient may require an emergent cesarean delivery at any time, it is recommended that an airway evaluation be performed on every obstetric patient when they are admitted, with repeat exams during the course of labor as well as immediately prior to induction of general anesthesia as airway anatomy can change during labor. The obstetric anesthesiology team should know where the nearest videoscope, bronchoscope, and jet ventilator are located on L&D.

Managing a difficult airway in an obstetric patient can be even more challenging compared to a non-pregnant patient because the anesthesiologist needs to consider two patients, the mother and her baby. Balki et al. developed an algorithm (Appendix 1) for the unanticipated difficult airway in an obstetric patient.[3] This algorithm was used to assess resident physician knowledge in high-fidelity simulation, and the poorest performance was identified during: 1) fetal distress and cannot intubate or ventilate mother, 2) maternal distress, cannot intubate but can ventilate the mother.[3] The joint publication by the Obstetric Anaesthetists' Association and Difficult Airway Society in the United Kingdom that describes the management of a difficult and failed tracheal intubation in an obstetric patient (Appendix 2) is a must read for any anesthesiologist.[4]

Educational Rationale: To teach team skills in recognizing and correctly managing an unanticipated difficult airway in an obstetric patient

Target Audiences: Anesthesiologists, Obstetricians, Resident Physicians, L&D nurses, L&D support personnel, and medical students

Learning Objectives: As per Accreditation Council for Graduate Medical Education (ACGME) Core Competencies. Upon completion of this simulation (including the debrief) learners will be able to:

- *Medical knowledge*: Describe common airway changes during pregnancy and explain why these make airway management more difficult
- *Patient care*: Ask appropriate preoperative questions and perform a focused physical exam to identify risk factors that may predispose a patient to a difficult airway and describe how the anesthetic plan should be modified to optimize intraoperative care and patient safety
- *Practice-based learning and improvement*: Effectively implement an interdisciplinary emergency response and identify all necessary skills and equipment needed to correctly manage an obstetric patient with an unanticipated difficult airway
- *Interpersonal and communication skills*: Utilize closed-loop communication with the surgical team, nursing team, and other anesthesiologists, and identify a team leader to ensure safety of the patient and infant
- *Professionalism*: Demonstrate compassion to the patient and her partner, and demonstrate mutual respect for each team member involved in the patient's care
- *Systems-based practice*: Identify the location of all emergency airway equipment and code carts, and understand existing barriers within the system such as shortage of equipment, personnel, knowledge gaps, and institutional protocols

Questions to Ask After the Scenario:
1. How quickly was an emergency response initiated?
2. Was a team leader identified and other roles clearly delegated and established?
3. Was closed-loop communication utilized?
4. Was the location of the videoscope, bronchoscope, and jet ventilator known?
5. Was the difficult airway algorithm followed?

Assessment Instruments:
1. Learner Knowledge Assessment form (Appendix 3)
2. Simulation Activity Evaluation form (Appendix 4)

Equipment Needed and Set-up:
In-situ patient room set-up
- Mannequin with left uterine displacement
- 18 gauge IV in left antecubital fossa
- Blood pressure cuff on mannequin

In-situ OR set-up
- Anesthesia machine and cart not set up for general anesthesia
- No airway equipment in OR

Needed but not necessarily in OR
- Airway equipment (videoscope, bronchoscope, jet ventilator)
- Invasive blood pressure equipment

Simulation Scenario Set-up:
The case
Ms. Sarah Jones is a 32-year-old primip (G1P0) at 39 weeks gestation who presented in active labor 8 hours ago. She had a straightforward pregnancy and is now contracting every 3-5 minutes. She is morbidly obese with a BMI of 45, with no medical or surgical history, no known allergies, and she last ate 4 hours ago. Her HR is 95 bpm, BP is 125/80 mm Hg, and oxygen saturation is 98% on room air, and she has a pain score of 6/10. The patient does not want neuraxial analgesia because she is worried about the risks. Over the past hour, the fetal heart tracing has been category 2 with minimal variability.

Height: 5'2" (157 cm)
Weight: 246 lbs (112 kg)
BMI: 45

Airway: Mallampati 2, normal mouth opening, thyromental distance >6.5 cm
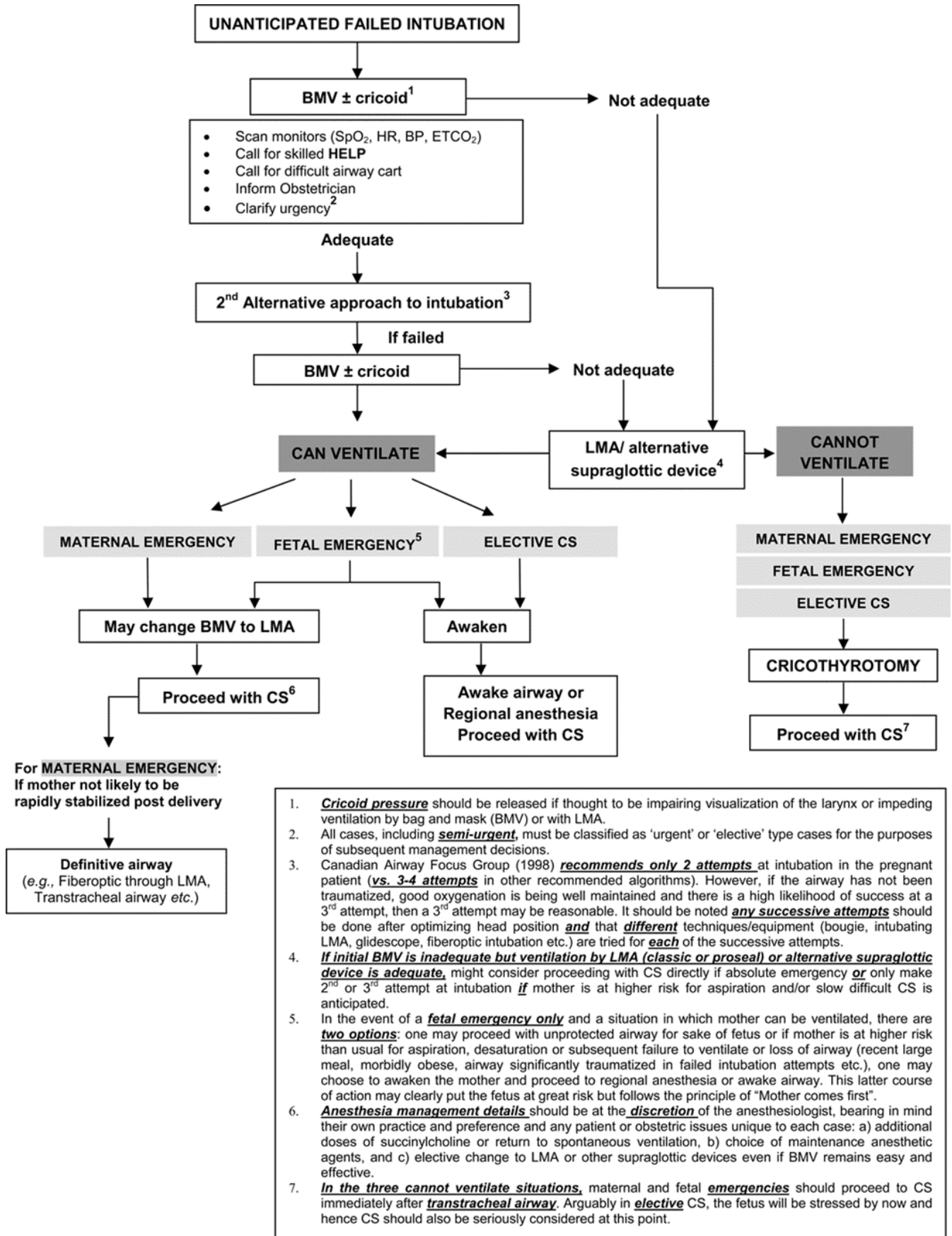
Simulation Pre-brief
- Read the scenario and instruct team members on their roles during the simulation
- Learners take their places at bedside
- The circulator nurse, neonatal nurse, scrub tech, and surgeon are in their appropriate places
- Simulation driver plays the voice of the patient
- Confederate plays the partner

Scenario Details

Trigger	Patient Condition	Action	Done	Time	Comments
Patient in LDR Has late deceleration Partner present at bedside	Patient in bed, appears anxious HR 95 bpm BP 105/75 mm Hg Resp 16/min O$_2$ sat 100% FHR 60/min	1. Bedside nurse calls for help 2. Nurse gives SBAR to the OB + anesthesiologist 3. OB examines patient 4. Optimize left lateral uterine displacement 5. Administer 1000 mL IV crystalloid bolus 6. Administer oxygen 10 L/min via non-rebreather facemask 7. OB requests sublingual nitroglycerine (uses closed-loop communication) 8. Anesthesiologist administers 2 sprays nitroglycerine SL (400 mcg/spray) 9. Reassure patient + partner			
Persistent fetal bradycardia with uterine tachysystole	Patient (+ partner) remain anxious HR 105 bpm BP 115/70 mm Hg Resp 18/min O$_2$ sat 100% FHR 60/min	1. OB requests nurse to administer terbutaline 250 mcg SC 2. Cycle blood pressure monitoring every 3-5 min 3. Repeat nitroglycerine administration (2 sprays SL) 4. Inform OR staff of potential case, + ensure set up for general anesthesia			
OB calls a stat cesarean delivery for sustained fetal bradycardia	Patient (+ partner) extremely anxious "Is my baby going to be okay?" HR 125 bpm BP 95/50 mm Hg Resp 22/min O$_2$ sat 100% FHR 62/min	1. Mobilize patient to OR 2. OB requests general anesthesia 3. Explain to patient + partner the need for general anesthesia (partner not allowed in OR due to general anesthesia) 4. Perform airway exam 5. Optimize positing (e.g. ramp) 6. Preoxygenate patient while placing standard ASA monitoring 7. OB team confirms FHR - plan to proceed with cesarean delivery 8. Reassure patient - explain what is happening			

Patient prepped + draped	Maternal vitals are normal pre-induction of anesthesia
	
	Patient desaturates (to 90%) during 1st intubation attempt
	
	Mask ventilation becomes difficult
		1. Anesthesiologist performs rapid sequence induction
		  □ Propofol + succinylcholine + cricoid pressure
		2. 1st intubation attempt
		  □ Unsuccessful with direct laryngoscopy
		  □ Perform bag-mask ventilation
		  □ Call for help
		  □ Call for additional airway equipment (i.e. videoscope/ fiberoptic)
		3. 2nd intubation attempt, without cricoid pressure (by a different anesthesiologist)
		  □ Unsuccessful with video-laryngoscopy
		  □ Perform bag-mask ventilation
		4. Anesthesiologist vocalizes that bag-mask ventilation is becoming increasingly difficult			

OB insists on starting the surgery	HR 120 bpm BP 110/86 mm Hg Resp 20/min O_2 sat 98% FHR 105/min	1. Anesthesiologist to discuss with the OB regarding waking the patient, or carrying on without a secure airway 2. Decision made to wake patient 3. Situation explained to patient, who agrees to proceed with neuraxial anesthesia 4. Neonate is successfully resuscitated by the NICU team			
Patient in PACU, comfortable + stable		1. Team debrief 2. Discuss system issues			
Update partner		1. Be compassionate & considerate when informing partner of life-saving interventions, and update re neonatal status			

Appendix 1[3]

UNANTICIPATED FAILED INTUBATION

BMV ± cricoid[1] → **Not adequate**

- Scan monitors (SpO₂, HR, BP, ETCO₂)
- Call for skilled **HELP**
- Call for difficult airway cart
- Inform Obstetrician
- Clarify urgency[2]

Adequate

2nd Alternative approach to intubation[3]

If failed

BMV ± cricoid → **Not adequate**

CAN VENTILATE ← **LMA/ alternative supraglottic device[4]** → **CANNOT VENTILATE**

From CAN VENTILATE:
MATERNAL EMERGENCY   **FETAL EMERGENCY[5]**   **ELECTIVE CS**

May change BMV to LMA   **Awaken**

Proceed with CS[6]

Awake airway or Regional anesthesia Proceed with CS

For **MATERNAL EMERGENCY:** If mother not likely to be rapidly stabilized post delivery

Definitive airway (*e.g.,* Fiberoptic through LMA, Transtracheal airway *etc.*)

From CANNOT VENTILATE:
MATERNAL EMERGENCY
FETAL EMERGENCY
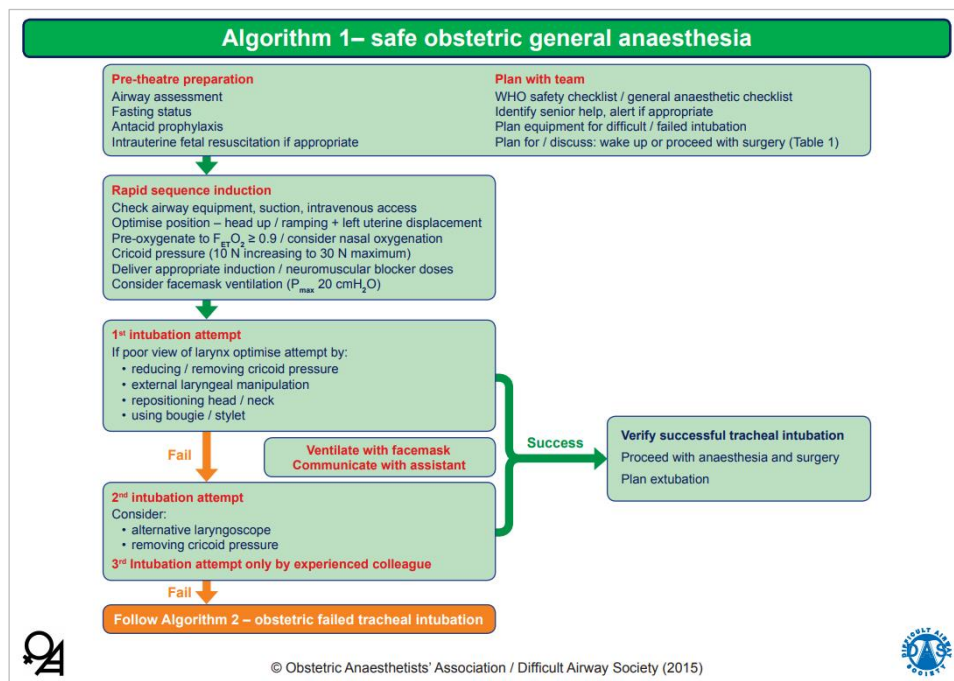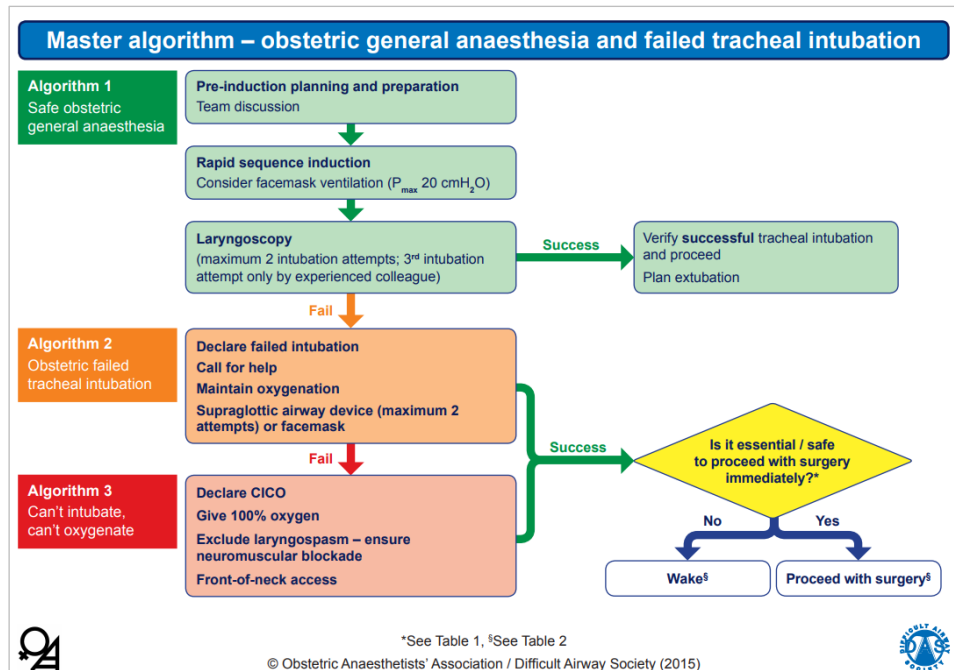**ELECTIVE CS**

CRICOTHYROTOMY

Proceed with CS[7]

1. *Cricoid pressure* should be released if thought to be impairing visualization of the larynx or impeding ventilation by bag and mask (BMV) or with LMA.
2. All cases, including *semi-urgent*, must be classified as 'urgent' or 'elective' type cases for the purposes of subsequent management decisions.
3. Canadian Airway Focus Group (1998) *recommends only 2 attempts* at intubation in the pregnant patient (*vs. 3-4 attempts* in other recommended algorithms). However, if the airway has not been traumatized, good oxygenation is being well maintained and there is a high likelihood of success at a 3rd attempt, then a 3rd attempt may be reasonable. It should be noted *any successive attempts* should be done after optimizing head position *and* that *different* techniques/equipment (bougie, intubating LMA, glidescope, fiberoptic intubation etc.) are tried for *each* of the successive attempts.
4. *If initial BMV is inadequate but ventilation by LMA (classic or proseal) or alternative supraglottic device is adequate,* might consider proceeding with CS directly if absolute emergency *or* only make 2nd or 3rd attempt at intubation *if* mother is at higher risk for aspiration and/or slow difficult CS is anticipated.
5. In the event of a *fetal emergency only* and a situation in which mother can be ventilated, there are *two options*: one may proceed with unprotected airway for sake of fetus or if mother is at higher risk than usual for aspiration, desaturation or subsequent failure to ventilate or loss of airway (recent large meal, morbidly obese, airway significantly traumatized in failed intubation attempts etc.), one may choose to awaken the mother and proceed to regional anesthesia or awake airway. This latter course of action may clearly put the fetus at great risk but follows the principle of "Mother comes first".
6. *Anesthesia management details* should be at the *discretion* of the anesthesiologist, bearing in mind their own practice and preference and any patient or obstetric issues unique to each case: a) additional doses of succinylcholine or return to spontaneous ventilation, b) choice of maintenance anesthetic agents, and c) elective change to LMA or other supraglottic devices even if BMV remains easy and effective.
7. *In the three cannot ventilate situations,* maternal and fetal *emergencies* should proceed to CS immediately after *transtracheal airway*. Arguably in *elective* CS, the fetus will be stressed by now and hence CS should also be seriously considered at this point.
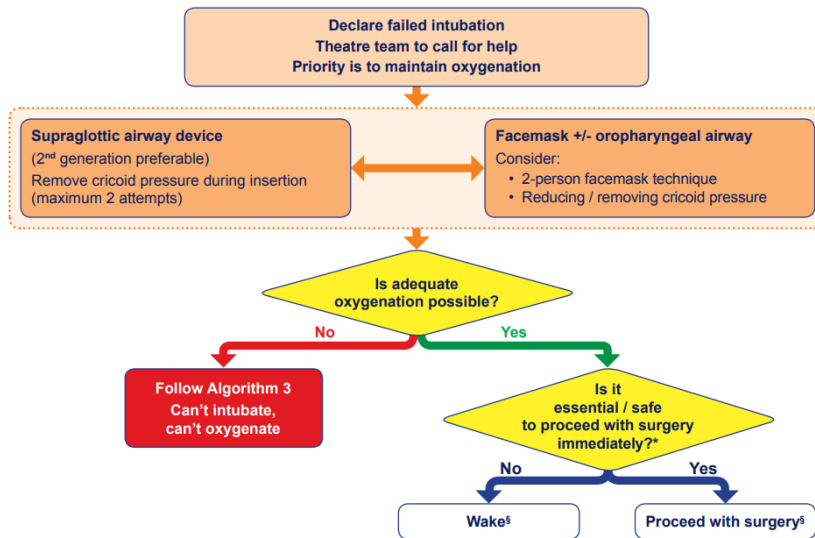
Master algorithm – obstetric general anaesthesia and failed tracheal intubation

Algorithm 1
Safe obstetric general anaesthesia

Pre-induction planning and preparation
Team discussion

Rapid sequence induction
Consider facemask ventilation (P_{max} 20 cmH$_2$O)

Laryngoscopy
(maximum 2 intubation attempts; 3rd intubation attempt only by experienced colleague)

Success → Verify **successful** tracheal intubation and proceed
Plan extubation

Fail ↓

Algorithm 2
Obstetric failed tracheal intubation

Declare failed intubation
Call for help
Maintain oxygenation
Supraglottic airway device (maximum 2 attempts) or facemask

Fail ↓

Algorithm 3
Can't intubate, can't oxygenate

Declare CICO
Give 100% oxygen
Exclude laryngospasm – ensure neuromuscular blockade
Front-of-neck access

Success → **Is it essential / safe to proceed with surgery immediately?***

No → **Wake§**   Yes → **Proceed with surgery§**

*See Table 1, §See Table 2
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Algorithm 1– safe obstetric general anaesthesia

Pre-theatre preparation
Airway assessment
Fasting status
Antacid prophylaxis
Intrauterine fetal resuscitation if appropriate

Plan with team
WHO safety checklist / general anaesthetic checklist
Identify senior help, alert if appropriate
Plan equipment for difficult / failed intubation
Plan for / discuss: wake up or proceed with surgery (Table 1)

Rapid sequence induction
Check airway equipment, suction, intravenous access
Optimise position – head up / ramping + left uterine displacement
Pre-oxygenate to $F_{ET}O_2 \geq 0.9$ / consider nasal oxygenation
Cricoid pressure (10 N increasing to 30 N maximum)
Deliver appropriate induction / neuromuscular blocker doses
Consider facemask ventilation (P_{max} 20 cmH$_2$O)

1st intubation attempt
If poor view of larynx optimise attempt by:
• reducing / removing cricoid pressure
• external laryngeal manipulation
• repositioning head / neck
• using bougie / stylet

Fail ↓

Ventilate with facemask
Communicate with assistant

Success → Verify successful tracheal intubation
Proceed with anaesthesia and surgery
Plan extubation

2nd intubation attempt
Consider:
• alternative laryngoscope
• removing cricoid pressure
3rd Intubation attempt only by experienced colleague

Fail ↓

Follow Algorithm 2 – obstetric failed tracheal intubation

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Algorithm 2 – obstetric failed tracheal intubation

Declare failed intubation
Theatre team to call for help
Priority is to maintain oxygenation

Supraglottic airway device
(2nd generation preferable)
Remove cricoid pressure during insertion
(maximum 2 attempts)

Facemask +/- oropharyngeal airway
Consider:
- 2-person facemask technique
- Reducing / removing cricoid pressure

Is adequate oxygenation possible?

No → **Follow Algorithm 3 Can't intubate, can't oxygenate**

Yes →

Is it essential / safe to proceed with surgery immediately?*

No → **Wake§**
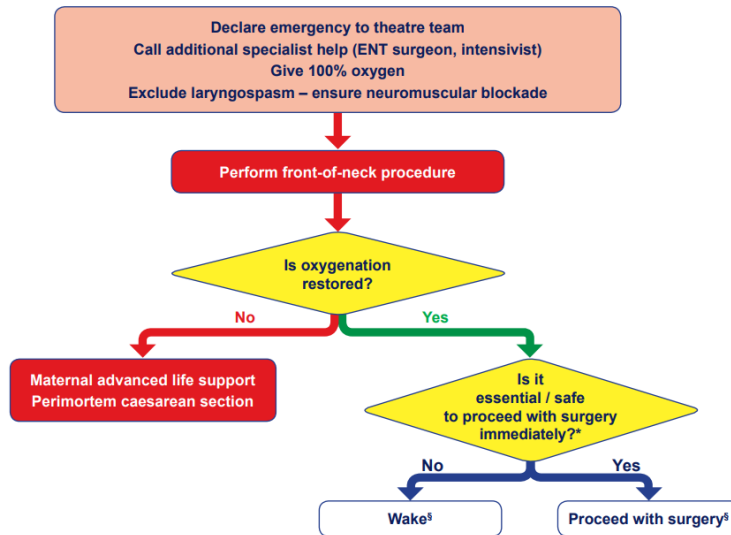
Yes → **Proceed with surgery§**

*See Table 1, §See Table 2
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Algorithm 3 – can't intubate, can't oxygenate

Declare emergency to theatre team
Call additional specialist help (ENT surgeon, intensivist)
Give 100% oxygen
Exclude laryngospasm – ensure neuromuscular blockade

Perform front-of-neck procedure

Is oxygenation restored?

No → **Maternal advanced life support Perimortem caesarean section**

Yes →

Is it essential / safe to proceed with surgery immediately?*

No → **Wake§**

Yes → **Proceed with surgery§**

*See Table 1, §See Table 2
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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.

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Table 2 – management after failed tracheal intubation

Wake

- Maintain oxygenation
- Maintain cricoid pressure if not impeding ventilation
- Either maintain head-up position or turn left lateral recumbent
- If rocuronium used, reverse with sugammadex
- Assess neuromuscular blockade and manage awareness if paralysis is prolonged
- Anticipate laryngospasm / can't intubate, can't oxygenate

After waking

- Review urgency of surgery with obstetric team
- Intrauterine fetal resuscitation as appropriate
- For repeat anaesthesia, manage with two anaesthetists
- Anaesthetic options:
  - Regional anaesthesia preferably inserted in lateral position
  - Secure airway awake before repeat general anaesthesia

Proceed with surgery

- Maintain anaesthesia
- Maintain ventilation - consider merits of:
  - controlled or spontaneous ventilation
  - paralysis with rocuronium if sugammadex available
- Anticipate laryngospasm / can't intubate, can't oxygenate
- Minimise aspiration risk:
  - maintain cricoid pressure until delivery (if not impeding ventilation)
  - after delivery maintain vigilance and reapply cricoid pressure if signs of regurgitation
  - empty stomach with gastric drain tube if using second-generation supraglottic airway device
  - minimise fundal pressure
  - administer H_2 receptor blocker i.v. if not already given
- Senior obstetrician to operate
- Inform neonatal team about failed intubation
- Consider total intravenous anaesthesia

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Appendix 3

<p align="center">**Learner Knowledge Assessment**</p>
<p align="center">**Labor and Delivery Multidisciplinary Team Simulation**</p>

Name of simulation: _____   Date: _____

OB   Nursing   Anesthesiology

Each item has two components. The "Before the simulation" column (left side) examines your perspective at the beginning of the simulation. The "End of Simulation" column (right side) is to evaluate your perspective at the completion of the simulation.

1. How would you rate your knowledge of the management of an unanticipated difficult airway in an obstetric patient?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7	1 2 3 4 5 6 7
Little/none Knowledgeable	Little/none Knowledgeable

2. How would you rate your knowledge of the changes that occur in anatomy and physiology that make airway management more difficult in an obstetric patient?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7	1 2 3 4 5 6 7
Little/none Knowledgeable	Little/none Knowledgeable

3. How would you rate your knowledge of how to induce general anesthesia in an obstetric patient?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7	1 2 3 4 5 6 7
Little/none Knowledgeable	Little/none Knowledgeable

4. How would you rate your knowledge of the location of the nearest video-laryngoscope, bronchoscope, and jet ventilator on your L&D floor?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7	1 2 3 4 5 6 7
Little/none Knowledgeable	Little/none Knowledgeable

5. How would you rate your knowledge of the difficult airway algorithm for an obstetric patient?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7	1 2 3 4 5 6 7
Little/none Knowledgeable	Little/none Knowledgeable

Appendix 4

Simulation Activity Evaluation

DATE OF SIMULATION: _____

OCCUPATION: Consultant   PG Yr 1 2 3 4   STUDENT   NURSE   MIDWIFE   OTHER

SPECIALTY:_____   YEARS IN PRACTICE: _____

Please rate the following aspects of this training program using the scale listed below:

1 = Poor   2 = Suboptimal   3 = Adequate   4 = Good   5 = Excellent

Use "N/A" if you did not experience or otherwise cannot rate an item

INTRODUCTORY MATERIALS

Orientation to the simulator	1	2	3	4	5	N/A

PHYSICAL SPACE

Realism of the simulator space	1	2	3	4	5	N/A

EQUIPMENT

Satisfaction with the mannequin	1	2	3	4	5	N/A

SCENARIOS

Realism of the scenarios	1	2	3	4	5	N/A
Ability of the scenarios to test technical skills	1	2	3	4	5	N/A
Ability of the scenarios to test behavioral skills	1	2	3	4	5	N/A
Overall quality of the debriefings	1	2	3	4	5	N/A

DID YOU FIND THIS USEFUL?

To improve your clinical practice?	1	2	3	4	5	N/A
To improve your teamwork skills?	1	2	3	4	5	N/A
To improve your VERBAL communication?	1	2	3	4	5	N/A
To improve your NONVERBAL communication?	1	2	3	4	5	N/A

FACULTY

Quality of instructors	1	2	3	4	5	N/A
Simulation as a teaching method	1	2	3	4	5	N/A

COMMENTS/SUGGESTIONS:

References

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