RISKS, STRATEGIES AND MANAGEMENT OF ANESTHETIC AND OBSTETRIC RELATED COMPLICATIONS

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DEPARTMENT OF ANESTHESIA AND OPERATING ROOMS

PHRAMONGKUTKLAO HOSPITAL

TABLE 22-1 Leading Causes of Maternal Death

Cause of Death	Number	(%)
Complications of preeclampsia	15	(16)
Amniotic fluid embolism	13	(14)
Obstetric hemorrhage	11	(12)
Cardiac disease	10	(11)
Pulmonary thromboembolism	9	(9)
Obstetric infection	7	(7)

Adapted from: Clark SL, Belfort MA, Dildy GA, et al. Maternal death in the 21st century: causes, prevention, and relationship to cesarean

OUTLINE

- Amniotic Fluid Embolism
- Venous embolism
- Difficult and failed intubation
- Pulmonary aspiration

AMNIOTIC FLUID EMBOLISM

TABLE 22-2 Amniotic Fluid Embolism National and UK Registries' Entry Criteria

Acute hypoxia
Acute hypotension/cardiac arrest
Coagulopathy
Onset of symptoms During labor Cesarean delivery Dilation and evacuation Within 30 min postpartum
Other possible diagnosis have been excluded
Occurrence within 5 yr of registry opening

Adapted from: Clark SL, Hankins GVD, Dudley DA, et al. Amniotic fluid embolism: analysis of the national registry. *Am J Obstet Gynecol* 1995;172(4 Pt 1):1158–1167; discussion 1167–1169.

ETIOLOGY

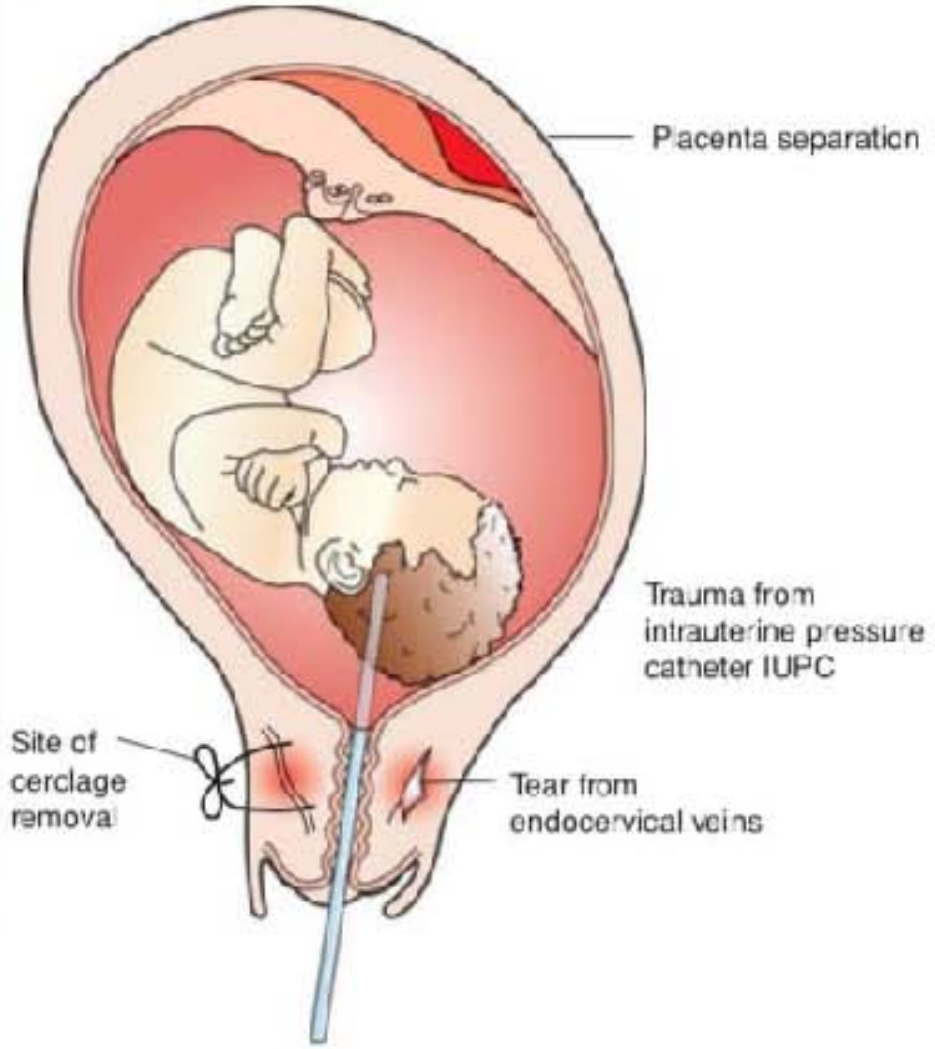


FIGURE 22-1 Possible sites of AFE into the maternal circulation.

RISK FACTORS

TABLE 22-3 Demographic Characteristics of Patients with Amniotic Fluid Embolism

Factor	Mean (+/−SD)
Maternal age	27 (+/−9)
Gravidity	3 (+/−2)
Parity	2 (+/−2)
Maternal weight (kg)	73 (+/−11)
Gestational age (wk)	39 (+/−2)
Birth weight (g)	3519 (+/−732)
Race	Number of patients (%)
White	29 (63)
Hispanic	8 (17)
Black	7 (15)
Asian	2 (4)
Male fetus	35/37 (67)
Twin gestation	1 (2)
Prior elective abortion	9 (20)
Prior spontaneous abortion	8 (17)
History of drug allergy or atopy	19 (41)

Adapted from Clark SL, Hankins GVD, Dudley DA, et al. Amniotic fluid embolism: analysis of the national registry. *Am J Obstet Gynecol* 1995;172(4 Pt 1):1158–1167; discussion 1167–1169.

RISK FACTORS

- Advanced Maternal Age and Multiple Pregnancies
- Amnioinfusion and Insertion of Intrauterine Pressure Catheter

RISK FACTORS

- AMNIOTOMY AND AMNIOCENTESIS
- ATOPY AND MALE FETUS
- BLUNT ABDOMINAL TRAUMA
  - Cervical Suture Removal
- CESAREAN DELIVERY
- EPIDURAL AND SPINAL BLOCKADE

RISK FACTORS

- Fetal Demise and Second Trimester Abortion
- Induction of Labor
- Multiple Gestations
- Meconium Staining of Amniotic Fluid
- Preeclampsia, Placental Abruption, and Placenta Previa
- Ruptured Membranes
- Uterine Rupture

CLINICAL PRESENTATION

- Pulmonary
- Cardiac
- Coagulopathy
- Neurologic
- Fetal

TABLE 22-4 Comparative Table of Signs and Symptoms of Amniotic Fluid Embolism

Signs and Symptoms	Knight Number of Patients (%)	Morgan Numbers of Patients (%)	Clark Number of Patients (%)
Maternal premonitory symptoms	28 (47)		
Respiratory		(51)	
Pulmonary edema/ARDS		65 (24)	28 (93)
Cyanosis			38 (83)
Dyspnea	37 (62)		22 (49)
Bronchospasm			7 (15)
Cough			3 (7)
Cardiac			
Hypotension	38 (63)	(27)	43 (100)
Cardiopulmonary arrest	24 (43)		40 (87)
Dysrhythmias	16 (27)		
Other			
Coagulopathy	37 (62)	(12)	38 (83)
Hemorrhage	39/60 (65)		11 (23)
Seizures	9 (15)	(10)	22 (48)
Fetal			
Fetal bradycardia	26 (43)		30 (100)

Adapted from: Knight M, Tuffnell D, Brocklehurst P, et al. UK Obstetric Surveillance System. Incidence and risk factors for amniotic-fluid embolism. Obstet Gynecol 2010;115(5):910–917.

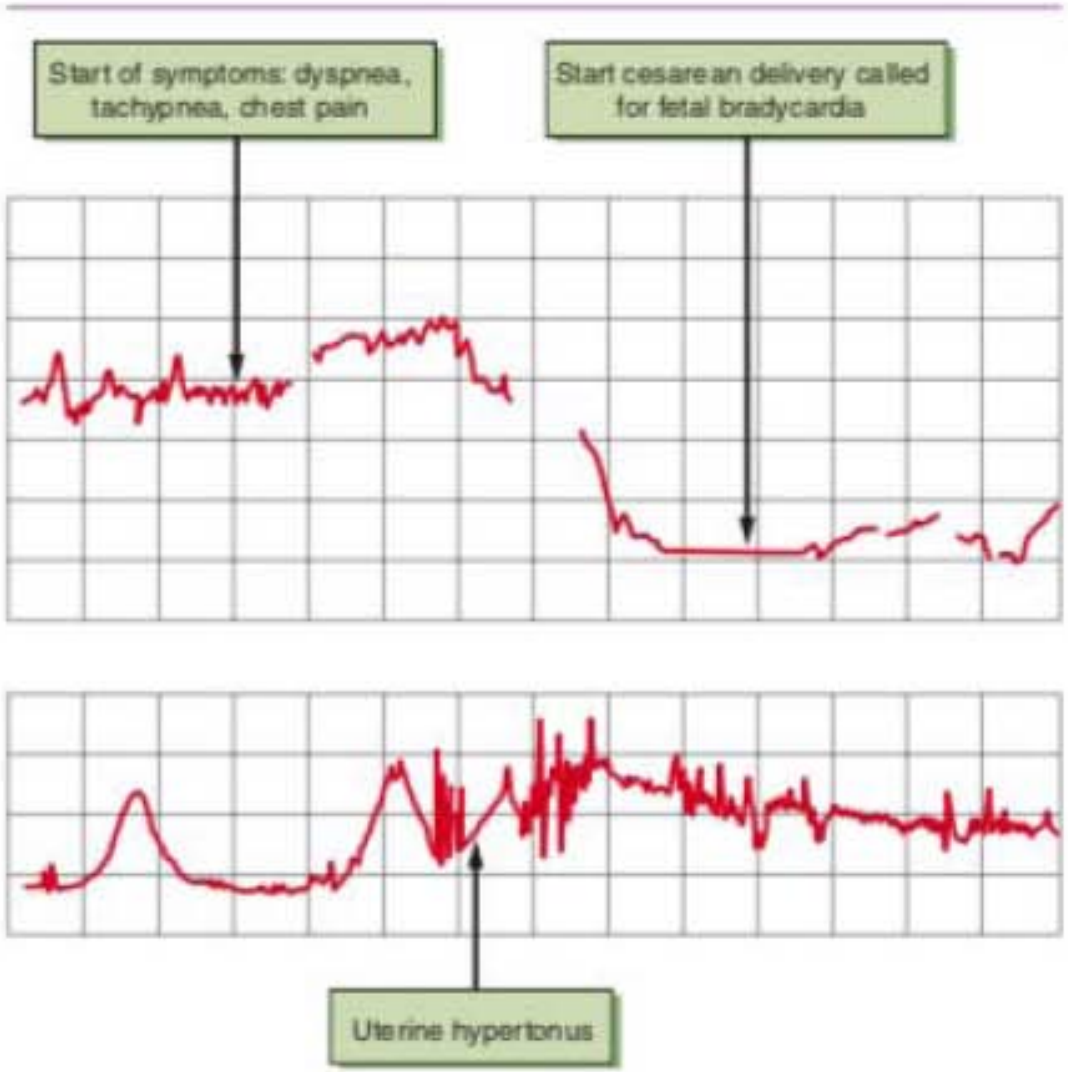
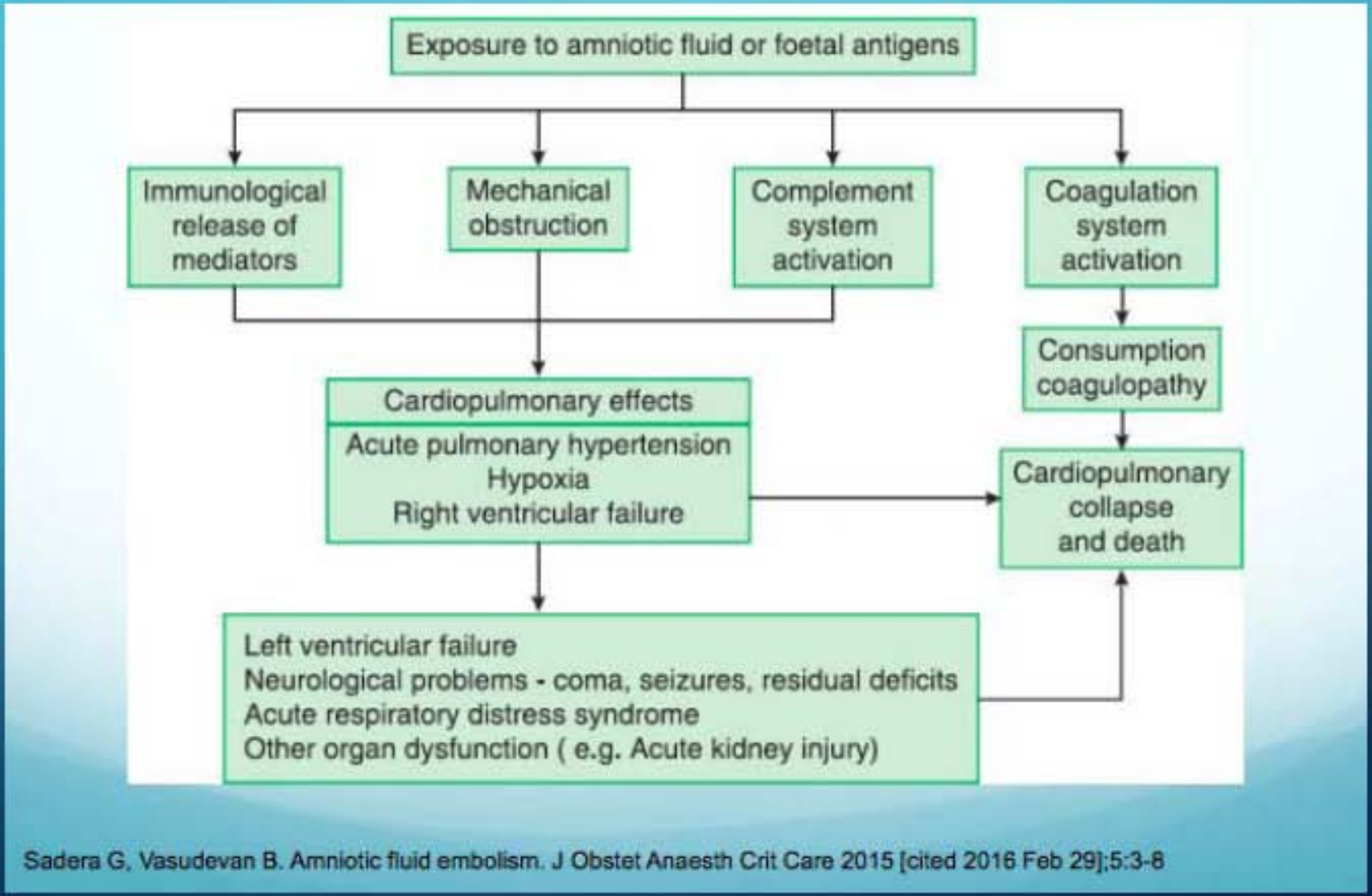


FIGURE 22-2 Fetal heart rate tracing in a patient with amniotic fluid embolism with clinical presentation and symptoms occurring during labor requiring aggressive resuscitation for shock and DIC.

PATHOPHYSIOLOGY



Sadera G, Vasudevan B. Amniotic fluid embolism. J Obstet Anaesth Crit Care 2015 [cited 2016 Feb 29];5:3-8

DIAGNOSIS

- Nonspecific and Specific Laboratory Tests
- Transesophageal Echocardiography

NONSPECIFIC AND SPECIFIC LABORATORY TESTS

TABLE 22-6 Nonspecific and Specific Laboratory Tests

Nonspecific
ECG
Tachycardia
Dysrhythmias
Ischemia
CBC
Decreased hemoglobin and hematocrit
Coagulation profile
Prolonged PT and PTT
Decreased fibrinogen
CHEST X-RAY
Pulmonary edema
ARDS
ARG
Respiratory acidosis
Hypoxemia
Intrapulmonary shunting
ECHOCARDIOGRAPHY
Acute left heart failure
V/Q scan
Pulmonary angiogram or spiral CT scan
Specific Biochemical Markers
Maternal zinc coproporphyrin, a component of meconium
Serum tryptase (normal <1 ng/mL)
Histologic examination: Squamous cells in the cervix, lungs, and other organs
A sensitive antimucin monoclonal antibody, TKH-2, immune-staining test detects AFE, by reacting with meconium and mucin-type glycoprotein, Sialyl Tn antigen, derived from AF, to stain the lung tissue
Identify amniotic debris in pulmonary edema fluid

DIFFERENTIAL DIAGNOSIS

TABLE 22-7 Differential Diagnosis of Amniotic Fluid Embolism

Obstetric Causes
Peripartum cardiomyopathy
Eclampsia
Placental abruption
Intrauterine infection or septic shock
Ruptured uterus
Postpartum hemorrhage
Anesthetic complications Total spinal or high epidural block Local anesthetic toxicity Pulmonary aspiration
Medication error
Nonobstetric causes
Pulmonary thromboembolism Air embolism Acute myocardial infarction Aortic dissection Adverse drug reaction or anaphylactic reaction Seizure Cerebral hemorrhage or cerebrovascular accident

CLINICAL

- Anaphylactic Response During Pregnancy
- Immunologic Response
- Anaphylactoid Syndrome During Pregnancy
- Arterial Blood Gases
- CBC with Platelets
- Prothrombin Time, Partial Thromboplastin, Fibrinogen
- Thromboelastography

CLINICAL

- Chest X-ray
- 12-lead ECG
- Monitoring
- Initial Cardiopulmonary Resuscitation
- Management

ANESTHETIC CONSIDERATIONS

- Oxygenation and Ventilatory Support
- Cardiovascular Support and Resuscitation
- Restore Uterine Tone
- Correction of Coagulopathy
- Obstetric and Surgical Control Hemorrhage
- Managing an in situ Epidural Catheter
- Newer Strategies in the Management of AFE

MATERNAL AND FETAL OUTCOMES

- Can Outcomes be Predicted and Affected?
- Use of Hypothermia
- Fetal Outcomes

VENOUS EMBOLISM

TABLE 23-1 Leading Causes of Maternal Death

Cause of Death	Number	%
Complications of preeclampsia	15	16
Amniotic fluid embolism	13	14
Obstetric hemorrhage	11	12
Cardiac disease	10	11
Pulmonary thromboembolism	9	9
Obstetric infection	7	7

Adapted from: Clark SL, Belfort MA, Dildy GA, et al. Maternal death in the 21st century: Causes, prevention, and relationship to cesarean delivery. *Am J Obstet Gynecol* 2008;199(1):36.e1–e5.

TABLE 23-3 Risk Factors for Venous Thromboembolism During Pregnancy

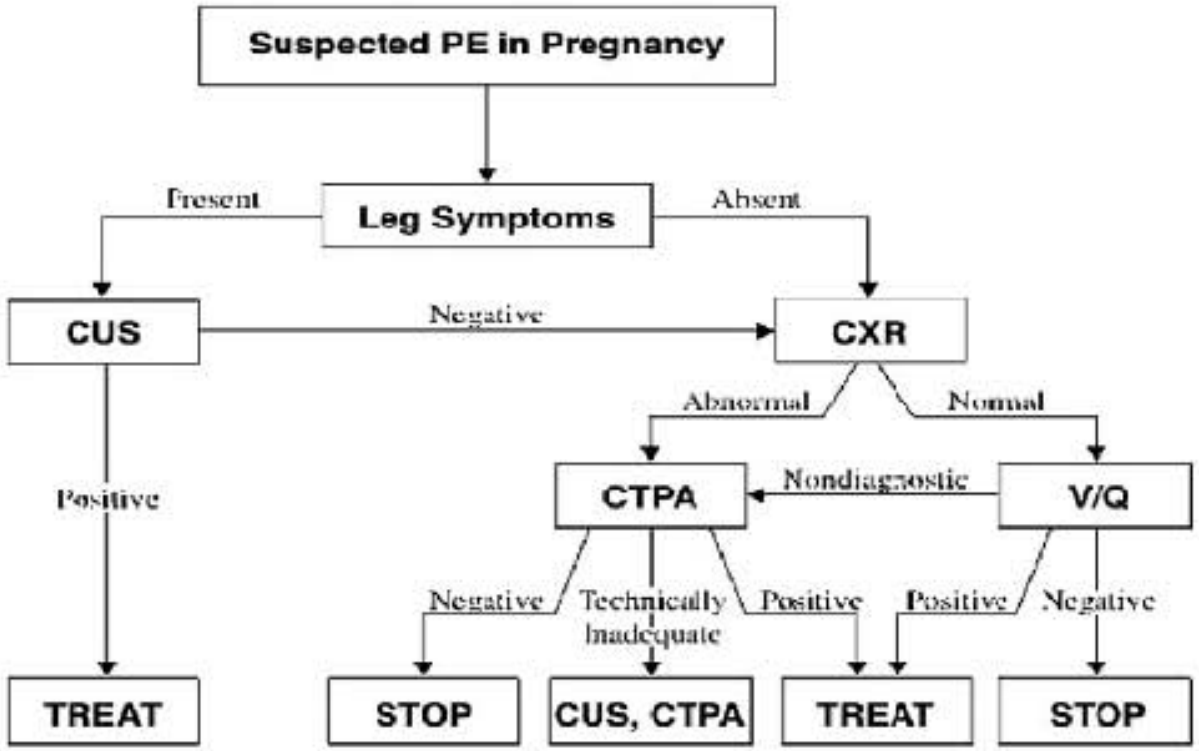
History of Previous VTE	Venous Stasis Disease
Family history of VTE	Surgery
Pregnancy and postpartum	Oral contraceptives
Prolonged bed rest or immobility	Smoking
Age greater than 35–40 yrs	Inflammatory bowel disease
Obesity	Indwelling central venous catheters
Trauma	Malignancy
Multiparity	Multiple gestation
Postcesarean hysterectomy	Inherited or acquired thrombophilias
Presence of antiphospho-lipid antibodies	

COMPLICATIONS OF VTE

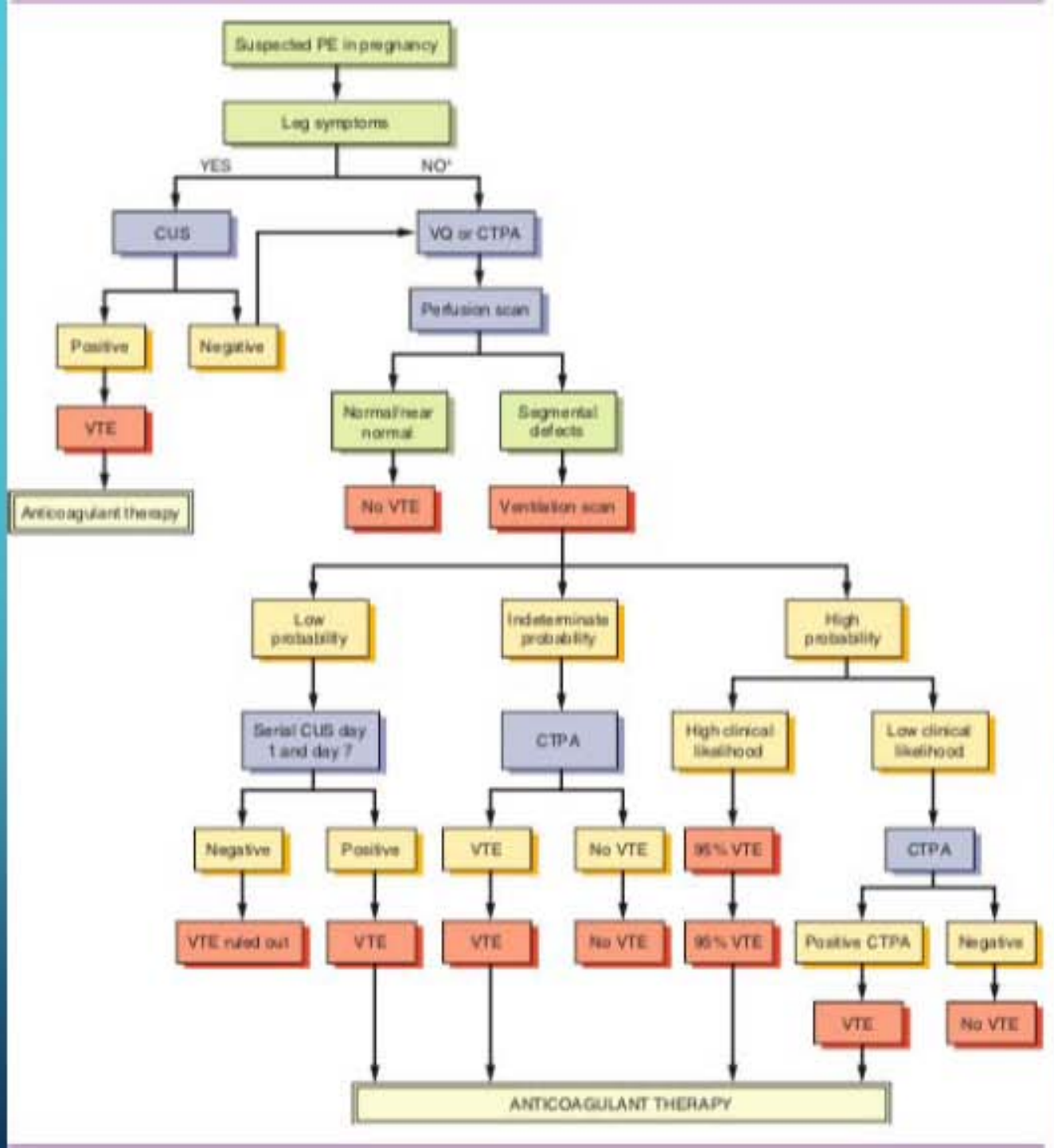
- Venous insufficiency
- Right-sided heart failure
- Post-thrombotic syndrome
- Pulmonary hypertension

DIAGNOSIS OF DVT AND PE

Diagnostic algorithm for suspected PE in pregnancy*



If PE is suspected and CUS and V/Q scanning services are not readily available, proceed immediately to CTPA to avoid a potentially lethal delay in treatment.


Suspected PE in pregnancy
Leg symptoms
YES
NO
CUS
VQ or CTPA
Positive
Negative
Perfusion scan
VTE
Normal/near normal
Segmental defects
Anticoagulant therapy
No VTE
Ventilation scan
Low probability
Indeterminate probability
High probability
Serial CUS day 1 and day 7
CTPA
High clinical likelihood
Low clinical likelihood
Negative
Positive
VTE
No VTE
95% VTE
CTPA
VTE ruled out
VTE
VTE
No VTE
95% VTE
Positive CTPA
Negative
VTE
No VTE
ANTICOAGULANT THERAPY

MANAGEMENT AND TREATMENT OF DVT/PE

- Heparin
- Low–molecular-weight Heparin
- Warfarin
- Aspirin
- Fondaparinux
- Thienopyridines
- Other options include thrombolysis, embolectomy, and IVC filters

TABLE 23-5 Pharmacology of Anticoagulant Drugs

Drug	Mode of Action	Route of Administration	Onset of Action	Elimination Half-Life
Unfractionated heparin	Bind ATIII	SC; IV	Within 2 h (SC); immediate (IV)	30, 60, 150 min (25 IU/kg, 100 IU/kg, 400 IU/kg)
LMWH	Bind ATIII	SC	±3–4 h	3–6 h; dose independent; prolonged in renal failure
Fondaparinux	Selective inhibition of factor Xa	SC	Within 2 h	17 h
Aspirin	Irreversible inhibition of COX-1	Oral	Within 5 h	7.5 h (of main metabolite)
Ticlodipine	Inhibit ADP-induced platelet aggregation	Oral	1–8 h	20–50 h
Warfarin	Inhibit y-carboxylation of factors II, VII, IX, X	Oral	Within 90 min	36–42 h

A summary of pharmacologic data (based on non-obstetric patients) for unfractionated heparin, LMWH, Fondaparinux, aspirin, clopidogrel, triclopidine, and warfarin.

AT, antithrombin; COX, cyclooxygenase; IV, intravenous; IU, international units; LMWH, low–molecular-weight heparin; SC, subcutaneous.

TABLE 23-6 American Society of Regional Anesthesia and Pain Medicine (ASRA) Guidelines Regarding Anticoagulation with LMWH and Neuraxial Anesthesia and Analgesia

1. Weigh risk of spinal hematoma versus benefits of regional anesthesia or analgesia for pregnant patients on LMWH when deciding to place a neuraxial block
2. The concomitant use of antiplatelet or oral anticoagulation medications increase risk of spinal hematoma
3. Patients receiving prophylactic LMWH, neuraxial block should be placed 10–12 h after the last dose of LMWH
4. Patients receiving high dose or therapeutic dose of LMWH, such as enoxaparin 1 mg/kg twice per day, or enoxaparin 1.5 mg/kg daily, neuraxial block should be placed no earlier than 24 h after the last dose.
5. The first dose of LMWH postoperatively depends on the prescribed dosing schedule
   a. Twice-daily dosing: The first dose of LMWH should be given no earlier than 24 h postoperatively. First dose of LMWH should be held for 2 h after indwelling epidural catheters are removed.
   b. Single-daily dosing: The first dose of LMWH should be given 6–8 h postoperatively. The second dose should be given no earlier than 24 h after first dose. Indwelling epidural catheters may be maintained and should not be removed less than 10–12 h after last dose of LMWH. Subsequent dose of LMWH should be held for 2 h after in situ catheters are removed.
6. If blood is seen during needle or catheter placement, the first dose of LMWH should be delayed 24 h postoperatively.

Adapted with permission from: Beilin Y. Thrombocytopenia and low molecular weight heparin in the parturient: Implications for neuraxial anesthesia. ASA Refresher Course in Anesthesiology. 2010;Course 202:1–7.

- COMPLICATIONS OF ANTICOAGULATION DURING PREGNANCY
- PREVENTION AND THROMBOPROPHYLAXIS

GUIDELINES FOR NEURAXIAL TECHNIQUES IN THE ANTICOAGULATED PREGNANT PATIENT

TABLE 23-7 US Guidelines for Timing of Neuraxial Anesthesia in Patients Receiving Anticoagulation

Drug	Timing of Anticoagulation
Unfractionated Heparin Subcutaneous	
Before neuraxial blockade/after catheter withdrawal	No time interval for 5,000 U twice daily Greater than 4 d, check platelet count
After neuraxial blockade/after catheter withdrawal	1 h
Unfractionated Heparin Intravenous	
Before neuraxial blockade/after catheter withdrawal	None recommended/2–4 h
After neuraxial blockade/after catheter withdrawal	1 h
Low-molecular-weight Heparin (LMWH) (prophylactic dose)	
Before neuraxial blockade/after catheter withdrawal	10–12 h
After neuraxial blockade/after catheter withdrawal	6–8 h first postoperative dose (single dosing) Second postoperative dose 24 h after first dose Regardless dosing schedule, wait 2 h after catheter removal
Low-molecular-weight Heparin (LMWH) (therapeutic dose)	
Before neuraxial blockade/after catheter withdrawal	24 h
After neuraxial blockade/after catheter withdrawal	24 h/>2 h
Fondaparinux Subcutaneous	
Before neuraxial blockade/catheter withdrawal	Recommended with single-shot spinal, aneuraxic blocks, no in situ catheter
After neuraxial blockade/catheter withdrawal	Recommended with single-shot spinal, aneuraxic blocks, no in situ catheters
Aspirin	No Contraindications
Clopidogrel/before neuraxial blockade/catheter withdrawal	7 d
Ticlopidine/before neuraxial blockade/catheter withdrawal	14 d
Warfarin	
Before neuraxial blockade/catheter withdrawal	Recommend normal INR ≤ 1.5
After neuraxial blockade/catheter withdrawal	May restart after catheter withdrawal

Adapted with permission from: Bucklin AJ, Carvalho B. Neuraxial anesthesia with anticoagulant drugs. Int J Obstet Anesth 2013;19(2):193–201. Copyright 2013.

TABLE 23-8 Summary of Guidelines for Neuraxial Anesthesia Following Anticoagulants and Thrombotic Drugs

	ACOG	ACCP	ASRA
General	Initial diagnostic test for acute DVT is CUS. Therapeutic anticoagulation with acute thromboembolism during current pregnancy or with mechanical heart valves Place PCD before cesarean delivery for all women and maintain in place until patient is ambulatory and anticoagulation is restarted Resume anticoagulation therapy no sooner than 4–6 h after vaginal delivery or 6–12 h after cesarean delivery	The use of antithrombotic agents is not recommended in patients without thrombophilia or women with thrombophilia in the absence of thromboembolism or poor pregnancy outcome Avoid or limit epidural analgesia to < 48 h, withdraw catheter when INR < 1.5 with warfarin Spinal safe, avoid epidural analgesia with fondaparinux Use of direct thrombin inhibitors, thrombolytics not addressed	Normal INR before neuraxial technique and withdraw catheter when INR < 1.5 with warfarin Delay needle placement 36–42 h after last fondaparinux dose, wait 6–12 h after catheter withdrawal for subsequent fondaparinux dose Avoid neuraxial techniques with direct thrombin inhibitors Absolute CI with thrombolytics
Following antiplatelet drugs		NSAIDs: no CI Discontinue clopidogrel 7 d before neuraxial blockade	NSAIDs: No CI Discontinue ticlopidine 14 d and clopidogrel 7 d

TABLE 23-8 Summary of Guidelines for Neuraxial Anesthesia Following Anticoagulants and Thrombotic Drugs

	ACOG	ACCP	ASRA
Following subcutaneous UFH	Women receiving either therapeutic or prophylactic oral anticoagulation may be converted to LMWH with similar dosing no later than 36 wks of pregnancy until 36 h before induction of labor or cesarean delivery. Convert to SC or IV UFH until 4–6 h before delivery	Needle placement 8–12 h after SC UFH dose; subsequent dose 2 h after block or epidural catheter withdrawal	No CI with twice-daily SC dosing and total daily dose < 10,000 U Consider holding SC UFH if neuraxial blockade is anticipated to be technically difficult Start IV UFH 1 h after neuraxial technique, remove catheter 2–4 h after last UFH dose, no delay required if traumatic Resume prophylaxis 12 h after cesarean or catheter withdrawal with twice-daily dose of 5,000 U of UFH Delay prophylaxis for 24 h with weight adjusted UFH dosing regardless of mode of delivery
Following subcutaneous LMWH	At least 36 h before and Withhold neuraxial blockade for 12 h after the last prophylactic dose of LMWH or 24 h after the last therapeutic dose of LMWH	Needle placement 8–12 h after LMWH dose; subsequent LMWH dose 2 h after block or catheter withdrawal. Indwelling catheter safe with twice-daily LMWH prophylactic dosing	Twice-daily prophylactic dosing: LMWH 24 h after surgery, regardless of technique; Remove neuraxial catheter 2 h before first LMWH dose Therapeutic dose: Delay block for >18 h Resume prophylaxis 12 h after cesarean delivery or catheter withdrawal with 40 mg enoxaparin once daily Delay prophylaxis for 24 h with LMWH 1 mg/kg every 12 h regardless of mode of delivery

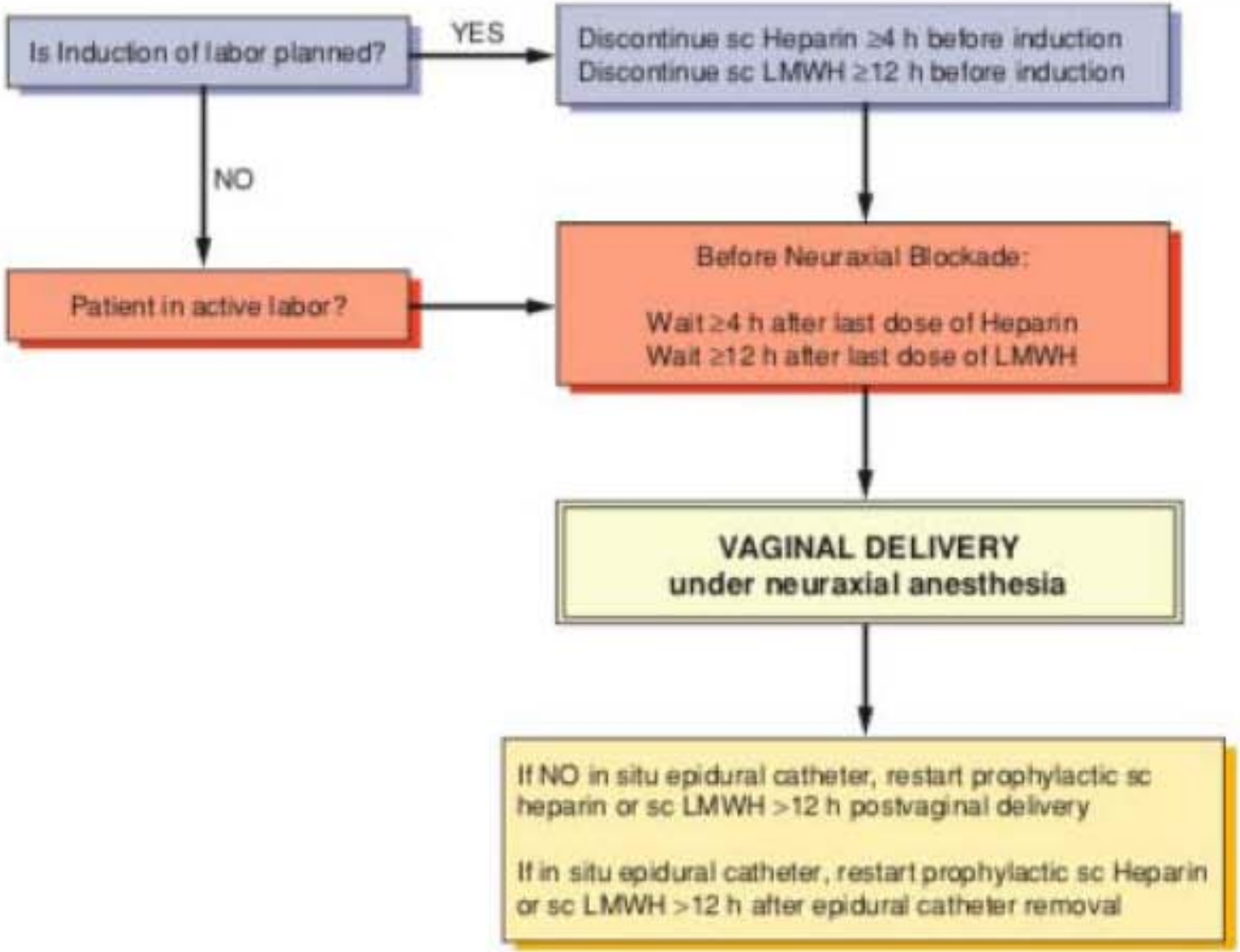


FIGURE 23-2 Vaginal delivery management: Prophylactic subcutaneous heparin or subcutaneous LMWH. Adapted with permission from: Butwick AJ Carvalho B. Algorithm for the timing of prophylactic subcutaneous heparin or LMWH administration before and after vaginal delivery. *J Perinat* 2011:31:73–84. Copyright 2011.

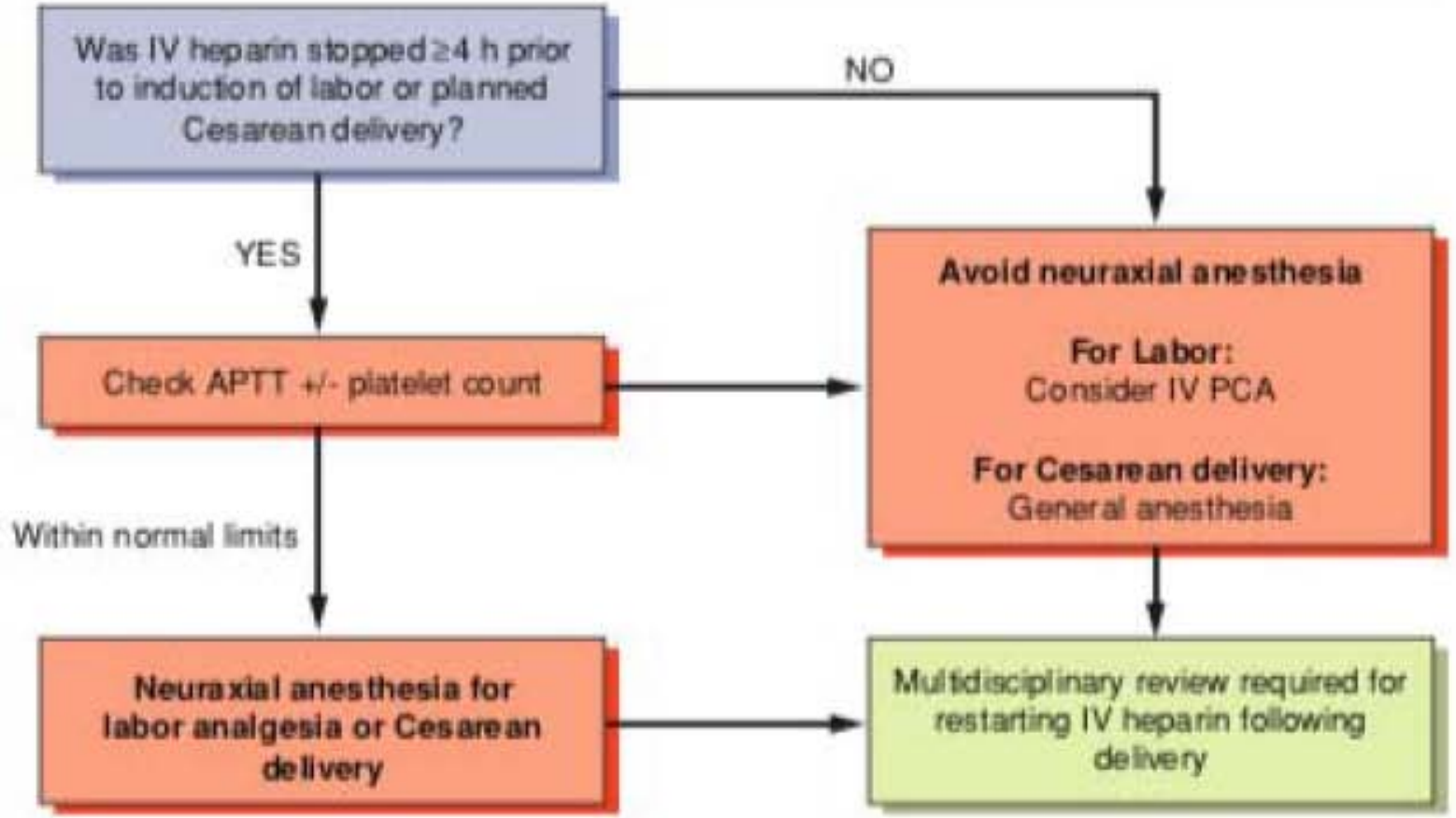


FIGURE 23-4 Peripartum management: Therapeutic intravenous heparin for vaginal or cesarean delivery. IV, intravenous; SC, subcutaneous; LMWH, low–molecular-weight heparin; PCA, patient controlled analgesia. Reprinted with permission from: Butwick AJ, Carvalho B. Algorithm for the timing of therapeutic low molecular weight heparin administration before and after vaginal or cesarean delivery. *J Perinat* 2011;31:73–84. Copyright 2011.

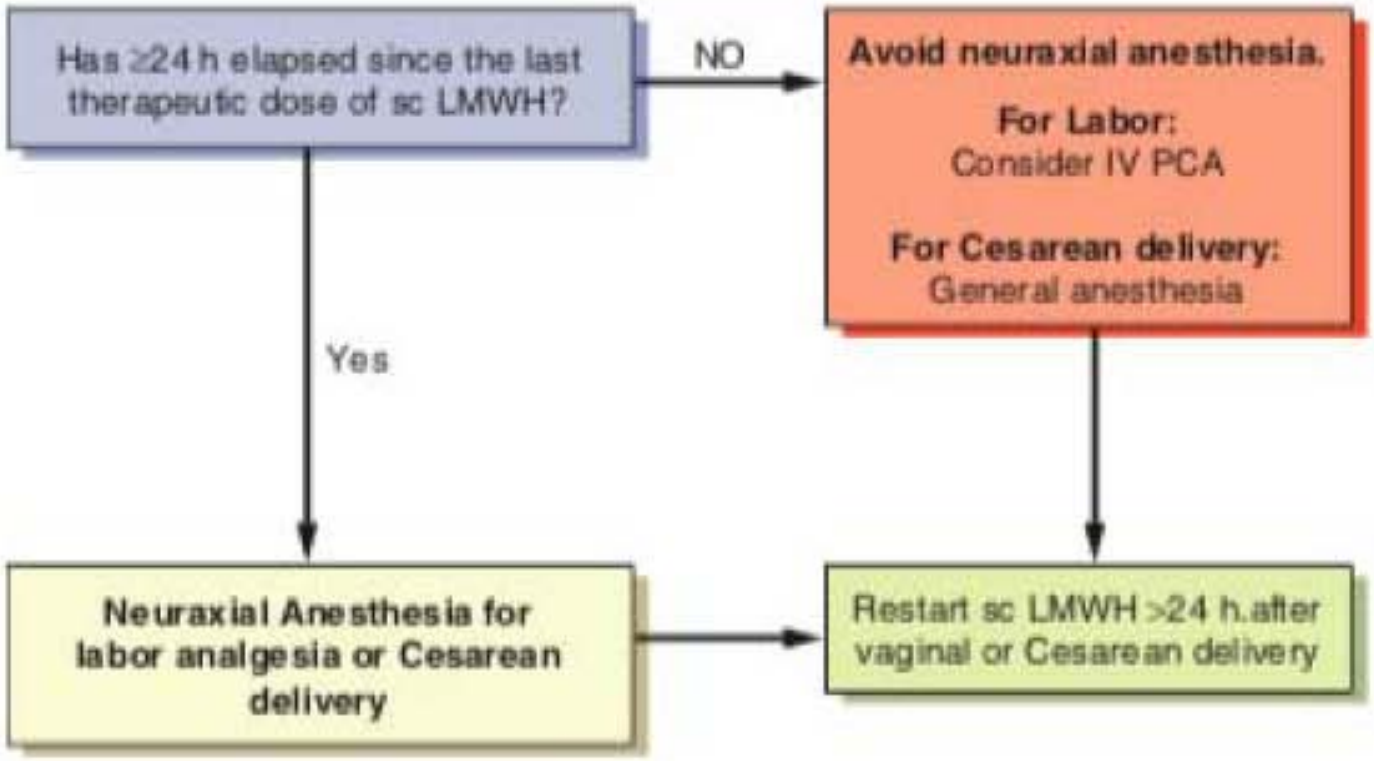


FIGURE 23-5 Peripartum management: Therapeutic SC LMWH for vaginal or cesarean delivery. IV, intravenous; SC, subcutaneous; LMWH, low-molecular-weight heparin; PCA, patient controlled analgesia. Reproduced with permission from: Butwick AJ, Carvalho B. Algorithm for the timing of therapeutic low molecular weight heparin administration before and after vaginal or cesarean delivery. *J Perinat* 2011;31:73–84. Copyright 2011.

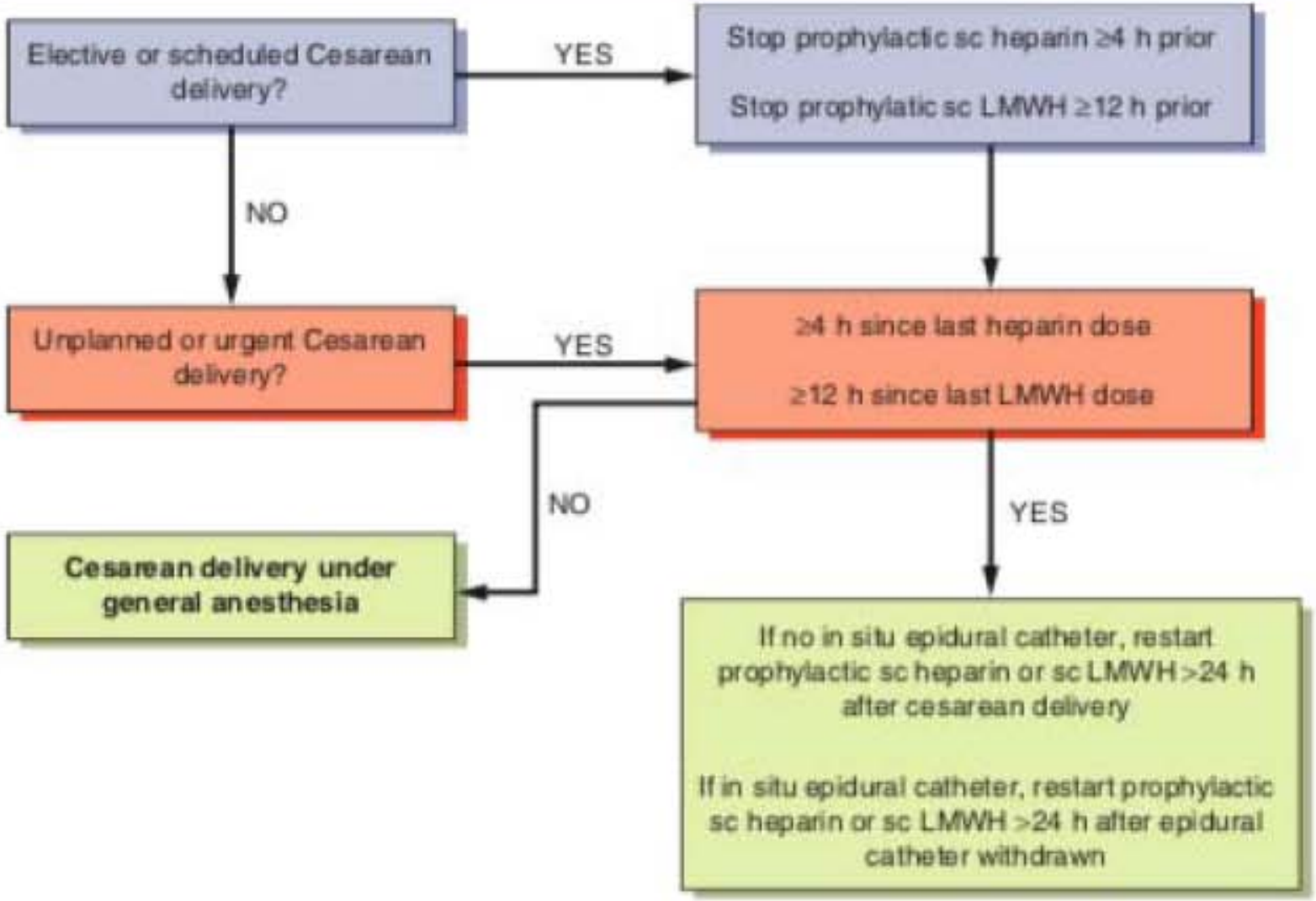


FIGURE 23-3 Cesarean delivery management: Prophylactic subcutaneous heparin or subcutaneous LMWH. Adapted with permission from: Butwick AJ, Carvalho B. Algorithm for the timing of prophylactic subcutaneous heparin or LMWH administration before and after cesarean delivery. *J Perinat* 2011;31:73–84. Copyright 2011.

DIFFICULT AND FAILED INTUBATION

GOALS AND STEPS IN OBSTETRIC ANESTHESIA WITH RELATION TO AIRWAY MANAGEMENT

Goals	Steps to Achieve Goals
Ensure safe outcomes for mother and baby	Be cognizant of predictors of the difficult airway
Establish oxygenation and ventilation; a priority which may require the use of alternative airway device	Assess risk factors that predispose to airway-related complications
Balance urgency of delivering the baby while keeping maternal safety in mind	Have an airway rescue plan, within the framework of a well thought out algorithm, for managing the difficult airway
Prevent regurgitation and pulmonary aspiration	Have airway devices/equipment/difficult airway cart *immediately* available in the labor and delivery suite and the operating rooms to manage the difficult airway
Eliminate airway-related maternal and neonatal adverse outcomes entirely	Acquire and maintain advanced airway management skills, including cricothyroidotomy skills

DEFINITIONS OF DIFFICULT AIRWAY

- *Difficult Tracheal Intubation*
- *Failed Intubation*
- *Difficult Laryngoscopy:*
- *Difficult Facemask Ventilation (MV):*
- *Difficult Laryngeal Mask Ventilation:*

TABLE 24-5 Difficult Airway Incidence

Surgical Patients	Obstetrical Patients
Difficult intubation occurs relatively commonly in association with GA Estimated incidence 1–3%	Cormack et al. Difficult laryngoscopy Grade III view 1:2,000
Difficult mask ventilation Estimated incidence 0.9–5% in general surgery patients	Hawthorne et al. Failed intubation 1:250

FACTORS CONTRIBUTING TO THE DIFFICULT MATERNAL AIRWAY

- Airway Changes
- Respiratory Changes
- Cardiovascular Changes and Resuscitation Implications
- Gastrointestinal Changes
- Obesity

PREDICTION OF DIFFICULT AIRWAY

- Importance of Assessment and Prediction of Difficult Airway in Obstetrical Patients
- Descriptive Terms Analyzing Predictive Tests
- Preoperative Assessment

TABLE 24-6 Preoperative Tests for Predicting DI in Obstetrical Patients

Sign of Difficulty	Description	Acceptable Findings not Usually Associated with Difficulty	Quantitative or Qualitative Findings Reported to be Associated with Difficulty
Disproportion	Increased size of tongue in relation to pharyngeal size	Mallampati class I or II	Mallampati class III or IV
Distortion	Airway swelling (preeclampsia) Airway trauma (blunt or penetrating) Neck mass (Thyroid enlargement)	Midline trachea Mobile laryngeal anatomy Easily palpated thyroid cartilage Easily palpated cricoid cartilage	Possibly difficult to assess Blunt or penetrating airway trauma Tracheal deviation Neck asymmetry Voice changes Laryngeal immobility Nonpalpable thyroid cartilage Nonpalpable cricoid cartilage
Decreased thyromental distance	Anterior larynx and decreased mandibular space	Thyromental distance ≥6.5 (3 fb) No receding chin	Thyromental distance <6.5 cm (<3 fb) measured from the superior aspect of the thyroid cartilage to the tip of the chin Receding chin
Decreased interincisor gap	Reduced mouth opening	Interincisor gap >3 cm (2 fb)	Distance between upper and lower incisors (i.e., interincisor gap) <3 cm (<2 fb)
Decreased range of motion in any or all of the joints of the airway (i.e., atlanto-occipital joint, temporo-mandibular joints, cervical spine); atlanto-occipital range of motion is critical for assuming the sniffing position	Limited head extension secondary to arthritis, diabetes, or other diseases Neck contractures secondary to burns or trauma	Head extension ≥35-degree atlanto-occipital extension Cervical spine flexion ≥35 degrees Long, thin neck	Head extension <35 degrees Neck flexion <35 degrees Long, thin neck
Dental overbite (upper lip bite test)	Protruding incisors disrupting the alignment of the airway axes and possibly decreasing the interincisor gap	No dental overbite	Dental overbite

PREDICTORS FOR DIFFICULT MASK VENTILATION

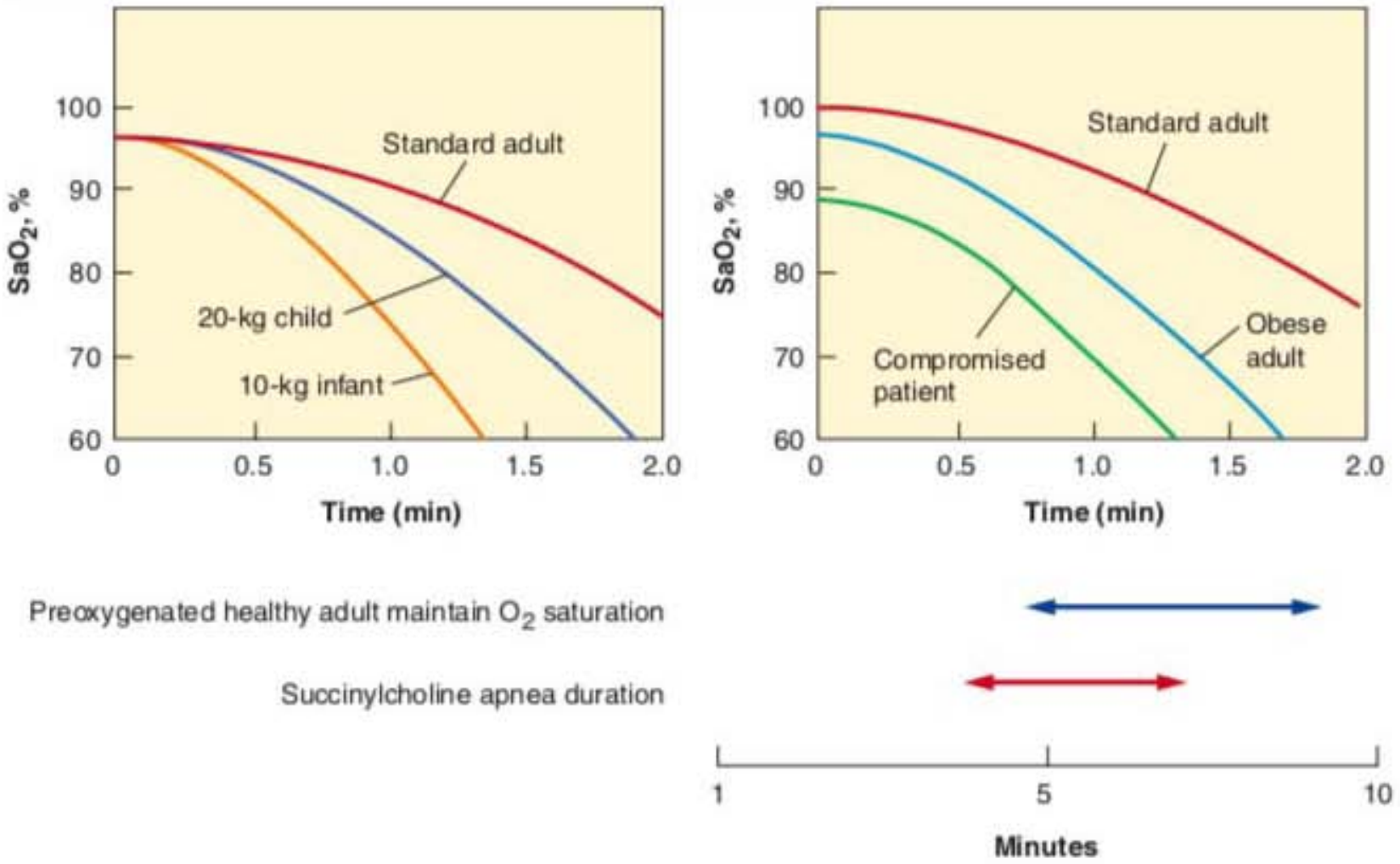
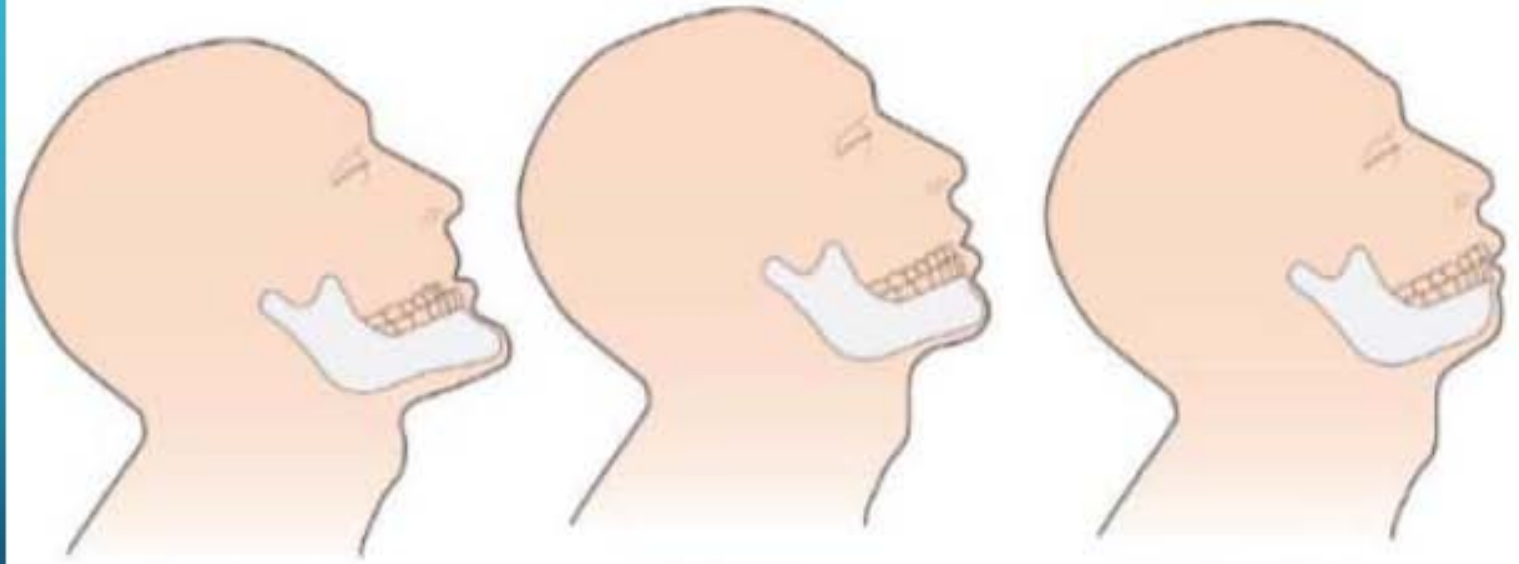


FIGURE 24-2 Oxyhemoglobin desaturation during apnea. Reprinted with permission from: Benumof JL, Dagg R, Benumof R. Critical hemoglobin desaturation will occur before return to an unparalyzed state following 1 mg/kg intravenous succinylcholine. *Anesthesiology* 1997;87(4):979–982.

SPECIFIC INDIVIDUAL TESTS FOR ASSESSMENT OF DIFFICULT TRACHEAL INTUBATION

- *Interincisor distance (limited mouth opening)*
- *Jaw Protrusion or Mandibular Protrusion test*
- *Upper lip bite test (ULBT)*
- *Atlanto-occipital (AO) joint extension*
- *Thyromental distance (TMD) (Patil's Test)*
- *Sternomental distance (SMD)*

MANDIBULAR PROTRUSION TEST



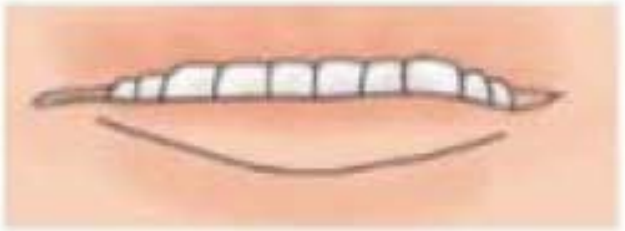
CLASS A
Lower incisors can be protruded anterior to the upper incisors

CLASS B
Lower incisors can be brought edge to edge with the upper incisors

CLASS C
Lower incisors cannot be brought edge to edge with the upper incisors

FIGURE 24-3 Mandibular protrusion test for prediction of difficult mask ventilation. Reprinted with permission from: Takenaka I, Aoyama K, Kadoya T. Mandibular protrusion test for prediction of difficult mask ventilation. *Anesthesiology* 2001;94(5):935.

UPPER LIP BITE TEST



Class I - Lower incisors can bite upper lip above vermilion line

Class II - Lower incisors can bite upper lip below vermilion line

Class III - Lower incisors cannot bite upper lip

MODIFIED MALLAMPATI TEST

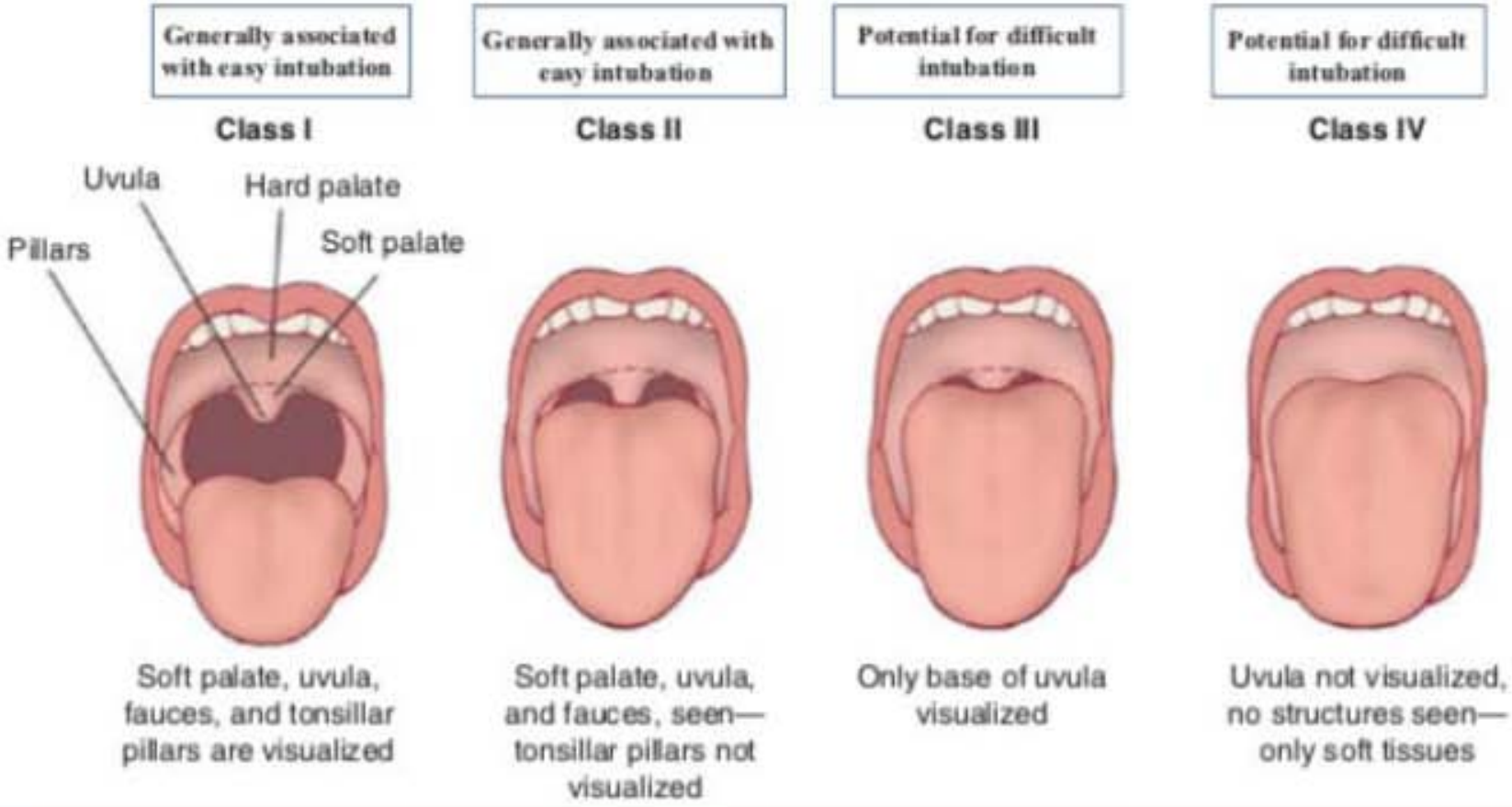
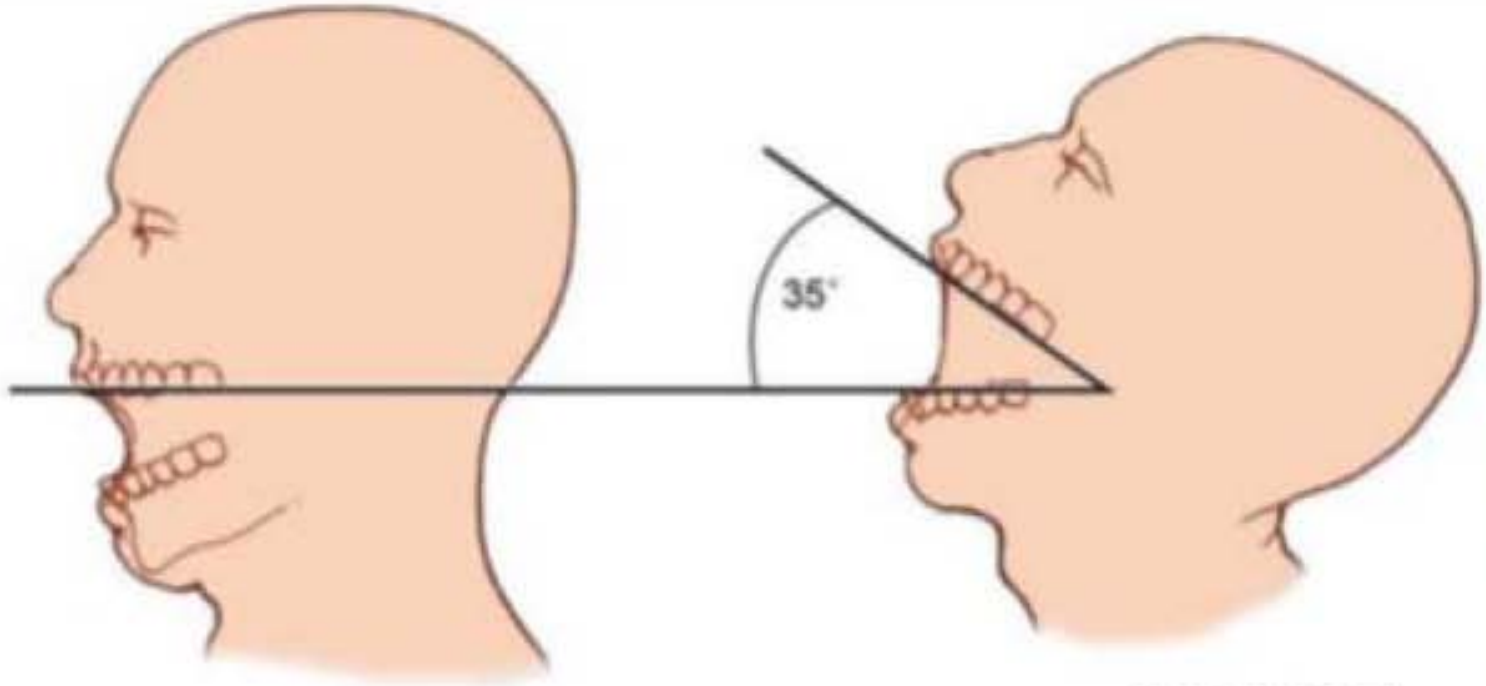


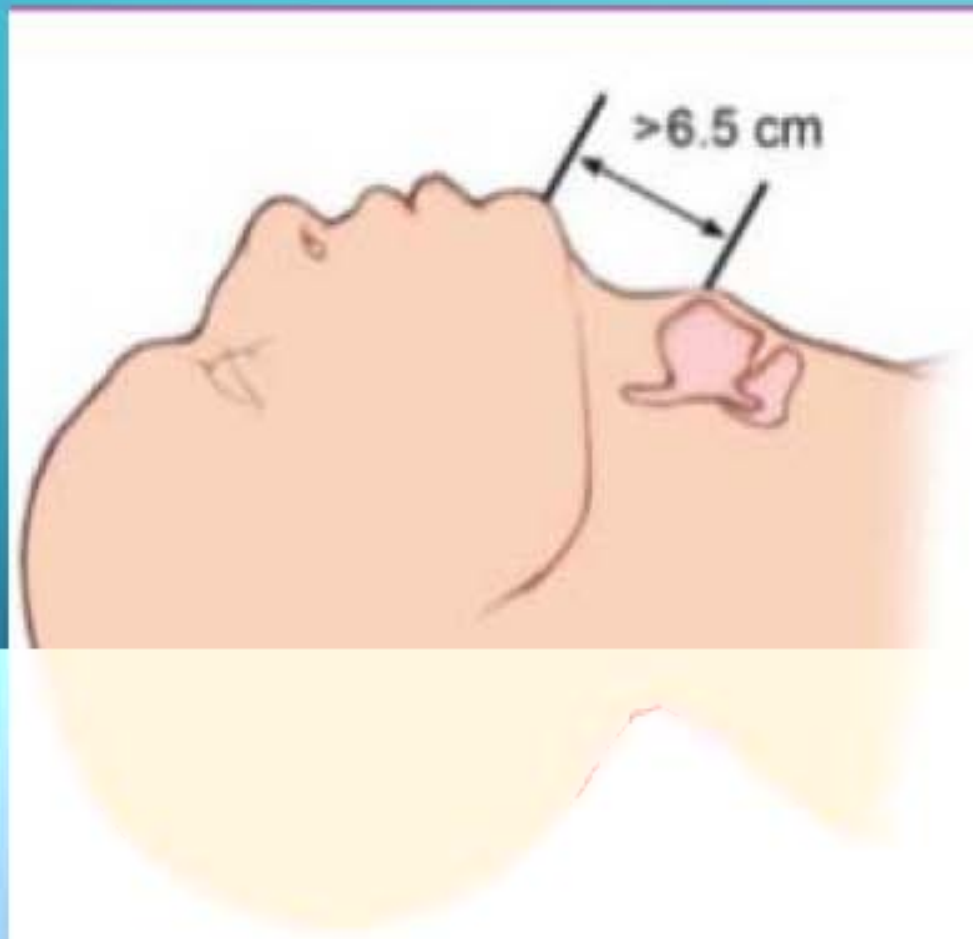
FIGURE 24-5 Difficulty of intubation. Modified from: Mallampati Classification. Samsoon GL, Young Jr. Difficult tracheal intubation: A retrospective study. *Anaesthesia* 1987;42:487–90; Mallampati SR, Gatt SP, Gugino LD, et al. A clinical sign to predict difficult tracheal intubation: A prospective study. *Can Anaesth Soc J* 1985;32 (4):429–434.

ATLANTO-OCCIPITAL (AO) JOINT EXTENSION



Grade	Reduction of atlantooccipital joint extension
1. No appreciable reduction of extension	None
2. Approximately 1/3 reduction	1/3
3. Approximately 2/3 reduction	2/3
4. No appreciable extension	Complete

THYROMENTAL DISTANCE (TMD) (PATIL'S TEST):



≥6.5 cm - Normal, easy intubation

6.0-6.5 cm - Laryngoscopy/ intubation difficult but may be possible

< 6.0 cm - Laryngoscopy, intubation impossible

PREDICTORS OF THE DIFFICULT AIRWAY IN OBSTETRICS

	Grade	Visualized Oral Anatomy	Potentional Intubation Implications
	1	Entire glottic opening from the anterior to posterior commissure	Should facilitate an easy intubation
	2	Just the posterior portion of glottis	Normally not difficult to pass a styleted tracheal tube through the laryngeal aperture
	3a*	Epiglottis only (epiglottis can be lifted using a laryngoscope blade)	Intubation is difficult, but possible using an Eschmann bougie introducer or flexible fiberoptic scope
	3b*	Epiglottis only (but epiglottis cannot be lifted from the posterior pharyx using a laryngoscope blade)	Intubation can be difficult, because insertion of an Eschmann bougie introducer may be impeded. Successful tracheal intubation can be accomplished with optical stylet or a flexible fiberoptic scope
	4	Only soft tissue, with no identifiable airway anatomy	Difficult intubation, requiring advanced techniques to intubate the trachea

**Tracheal intubation normally requires an advanced airway technique beyond direct laryngoscopy.*

COMBINING TESTS TO BETTER PREDICT DIFFICULT INTUBATION IN OBSTETRICS

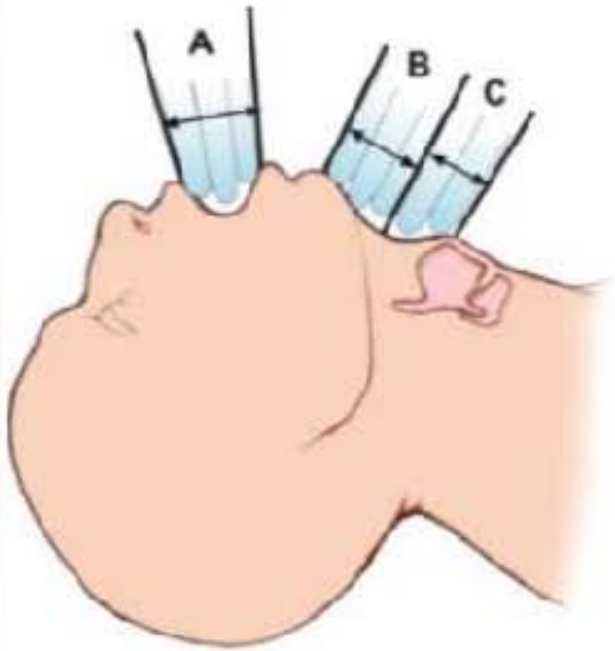
- *Using MP classification and Wilson Risk Sum*
- *Using MP classification, TMD, SMD, Mandibulo-hyoid dis- tance and IID*
- *Meta-analysis of Bedside Screening Test Performance*
- *Quantitative Evaluation of Difficult Intubation*—**Lemon Test**

TABLE 24-9 LEMON: Airway Assessment Method

L = Look externally for anatomic feature that may make intubation difficult
E = Evaluate the 3-3-2 rule – Mouth opening (3 fb) – Hyoid–chin distance (3 fb) – Thyroid cartilage-floor of mouth distance (2 fb)
M = Mallampati score – Class 1: Soft palate, uvula, pillars visible – Class II: Soft palate, uvula visible – Class III: Soft palate, base of uvula visible – Class IV: Hard palate visible
O = Obstruction: Examine for partial or complete upper airway obstruction.
N = Neck mobility

fb, finger breadths.

Reprinted with permission from: Reed MJ, Dunn MJ, McKeown DW. Can an airway assessment score predict difficulty at intubation in the emergency department? *Emerg Med J* 2005;*22*(2):99–102.



A. Inter-incisor distance in fingers (3 fb)

B. Hyoid mental distance in fingers (3 fb)

C. Thyroid to floor of mouth in fingers (2 fb)

FIGURE 24-11 LEMON airway assessment method. Murphy MF, Wall RM. The difficult and failed airway. Reprinted with permission from: Murphy MF, Walls RM. The difficult and failed airway. Manual of Emergency Airway Management. Chicago, Illinois: Lippincott Williams & Wilkins; 2000: 31–39, fb, finger breadths.

ANESTHETIC MANAGEMENT IN OBSTETRIC PATIENTS WITH A DIFFICULT AIRWAY

- Management of the parturient with a predicted difficult airway undergoing (i) labor or (ii) operative delivery, where airway management is not necessary;
- Management of anticipated difficult airway in a parturient undergoing CD, where airway management is necessary;

ANESTHETIC MANAGEMENT IN OBSTETRIC PATIENTS WITH A DIFFICULT AIRWAY

- Management of unanticipated difficult airway following rapid sequence induction
- Management of a CICV (cannot-intubate/cannot-ventilate) situation using (i) noninvasive airway rescue devices and (ii) invasive airway rescue devices during increasing hypox- emia, in the context of an emergency cesarean delivery and urgency to deliver the baby

ANESTHETIC MANAGEMENT OF THE PARTURIENT WITH A PREDICTED DIFFICULT AIRWAY

- Labor
- Operative Delivery

TABLE 24-10 Factors Associated with Difficult Airway

Previous history of difficult airway
Morbid obesity
Diabetes, acromegaly, rheumatoid arthritis, obstructive sleep apnea, osteogenesis imperfecta
Trauma, facial burn injuries, swelling, head and neck infection, hematoma of the mouth, tongue, pharynx, larynx, trachea, or neck
Large tongue, receding jaw, high arched palate, prominent upper incisors, short thick neck, large breasts, microstomia, fixed or "high" larynx
Mouth opening, 2–3 cm, jaw protrusion class C, Mallampati class 3 or 4, thyromental distance <6 cm, reduced head/neck mobility
Voice change, shortness of breath, difficulty swallowing, choking stridor, inability to lie flat, drooling of saliva, lingular tonsillar hyperplasia

MANAGEMENT OF PREDICTED DIFFICULT AIRWAY IN A PARTURIENT UNDERGOING CESAREAN DELIVERY, WHERE AIRWAY MANAGEMENT IS NECESSARY

- **Awake Tracheal Intubation**
  - Patient counseling
  - Patient consent
  - Use of an anti-sialagogue
  - Judicious sedation
  - Airway topicalization with local anesthetic
  - Clinical pearls to successful fiberoptic technique

CLINICAL PEARLS TO SUCCESSFUL FIBEROPTIC TECHNIQUE

- Measure the distance from the corner of the mouth to the ear
- Keep the fiberscope straight and follow the midline of the hard palate
- Advance the fiberscope to 10 cm and look at the video monitor to visualize identifiable airway structures
- Make small movements with the lever as you advance the bronchoscope
- If the beveled tip of the tracheal tube impinges on the right arytenoid cartilage, try pulling back the tracheal tube

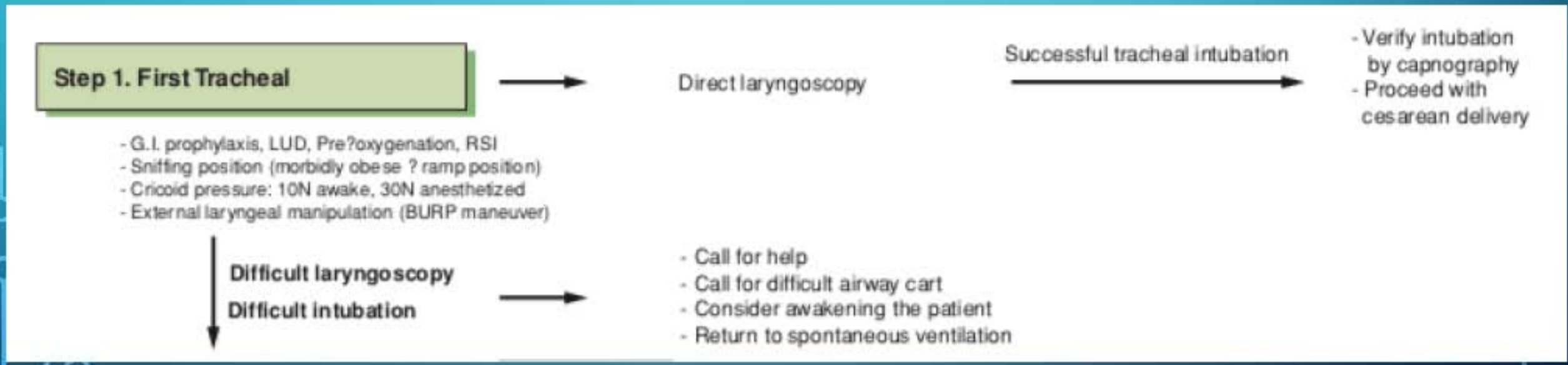
CLINICAL PEARLS TO SUCCESSFUL FIBEROPTIC TECHNIQUE

- Identify the carina, advance the fiberscope to three rings above carina, note do not touch the carina
- Ask the patient to inhale deeply, before advancing the tube to its final position and removing the scope

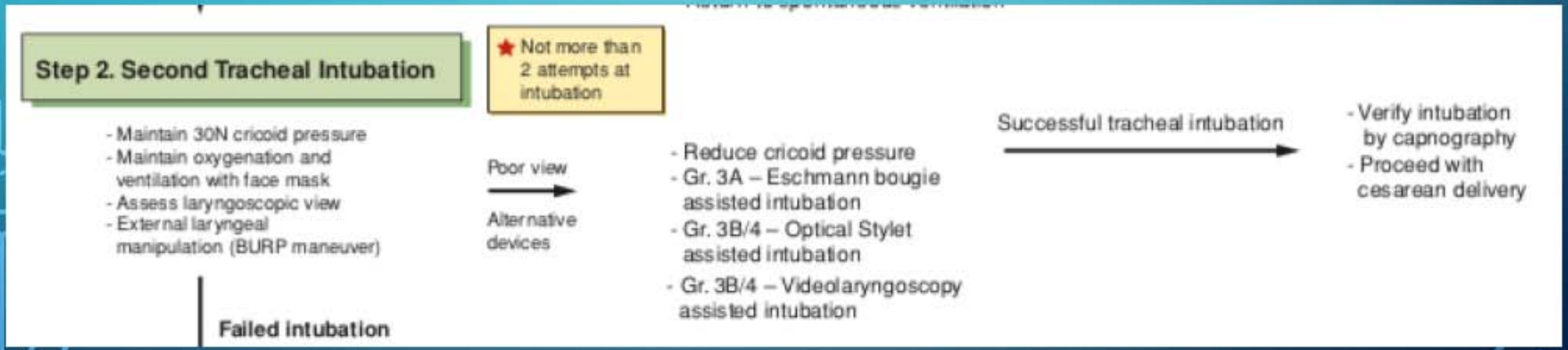
MANAGEMENT OF THE UNANTICIPATED DIFFICULT AIRWAY FOLLOWING RAPID SEQUENCE INDUCTION OF ANESTHESIA

- Proper planning
- Aspiration prophylaxis
- Proper positioning — Head Elevated Laryngoscopy Position (HELP)
- Left uterine displacement
- Optimal preoxygenation.

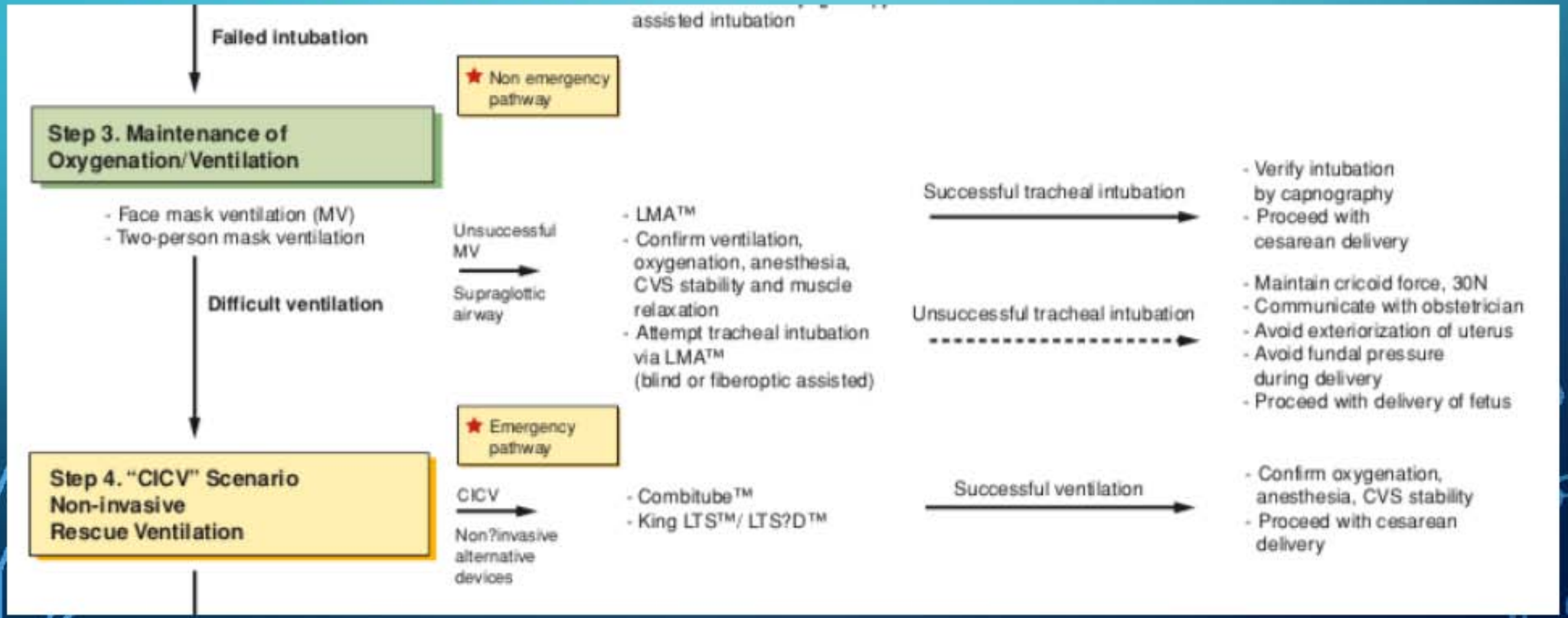
UNANTICIPATED DIFFICULT TRACHEAL INTUBATION, DURING RAPID SEQUENCE INDUCTION OF ANESTHESIA, IN THE OBSTETRIC PATIENT



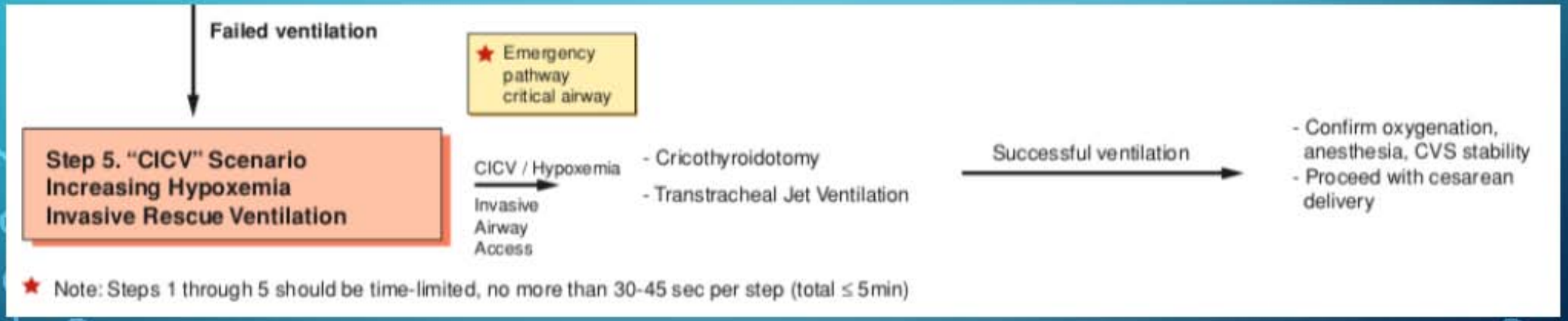
UNANTICIPATED DIFFICULT TRACHEAL INTUBATION, DURING RAPID SEQUENCE INDUCTION OF ANESTHESIA, IN THE OBSTETRIC PATIENT



UNANTICIPATED DIFFICULT TRACHEAL INTUBATION, DURING RAPID SEQUENCE INDUCTION OF ANESTHESIA, IN THE OBSTETRIC PATIENT



UNANTICIPATED DIFFICULT TRACHEAL INTUBATION, DURING RAPID SEQUENCE INDUCTION OF ANESTHESIA, IN THE OBSTETRIC PATIENT



CRICOID PRESSURE

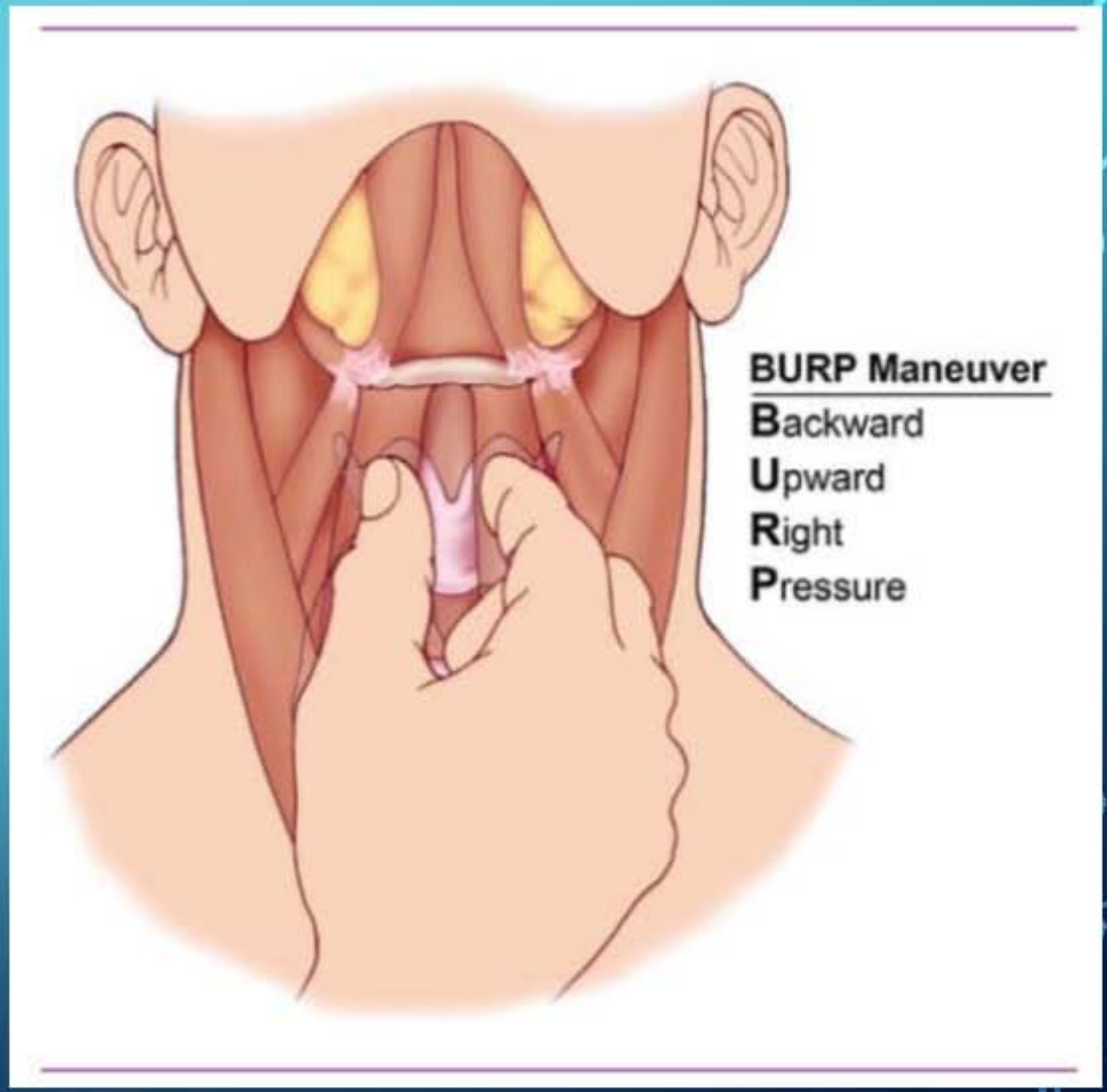


TABLE 24-11 Difficult Airway Cart Contents

Location	Contents
Top shelf	Prep items for awake intubation Eschmann bougie Optical Stylet
Side slot	Fiberoptic bronchoscope
Drawer A	Supraglottic airway sizes 3 and 4: LMA Classic™, LMA Fastrach™, LMA Proseal™, LMA Supreme™
Drawer B	Specialized supraglottic airways: Combitube™ SA 37 Fr, King LTS-D™
Drawer C	Invasive airway equipment: Cricothyroid

TECHNIQUE

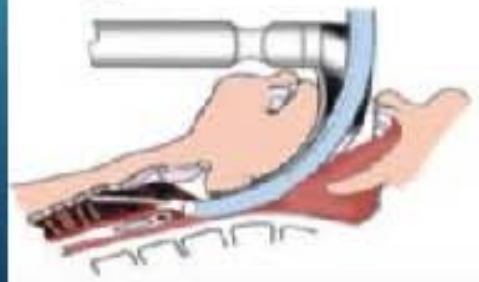
- Eschmann Bougie
- Optical Stylets
- Video laryngoscopy
  - McGrath
  - Glidescope
  - Storz C-Mac Video laryngoscopes

ESCHMANN BOUGIE-GUIDED TRACHEAL INTUBATION

- Distal 3 cm is angulated 35°, tip should be introduced pointing anteriorly

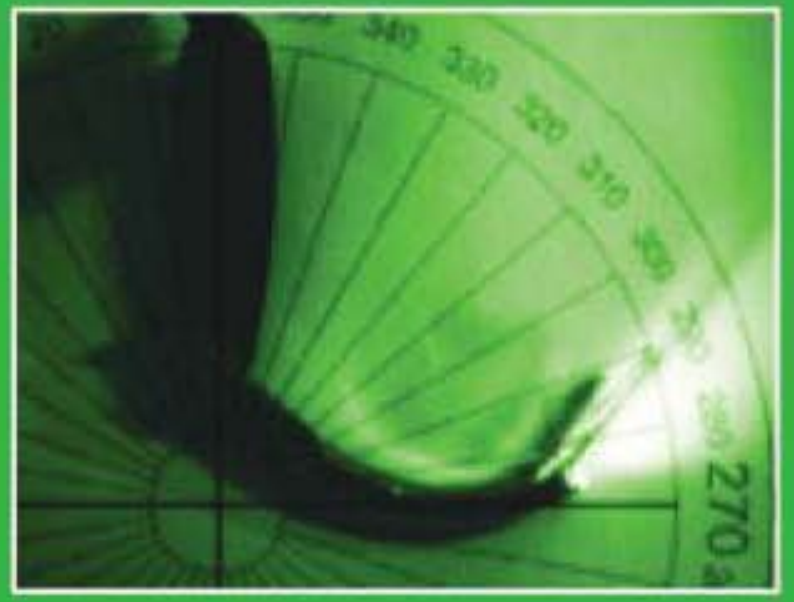
- Tip of Eschmann Bougie passes under the epiglottis

- When passing through the trachea, the tip vibrates or tracheal ring clicks are felt

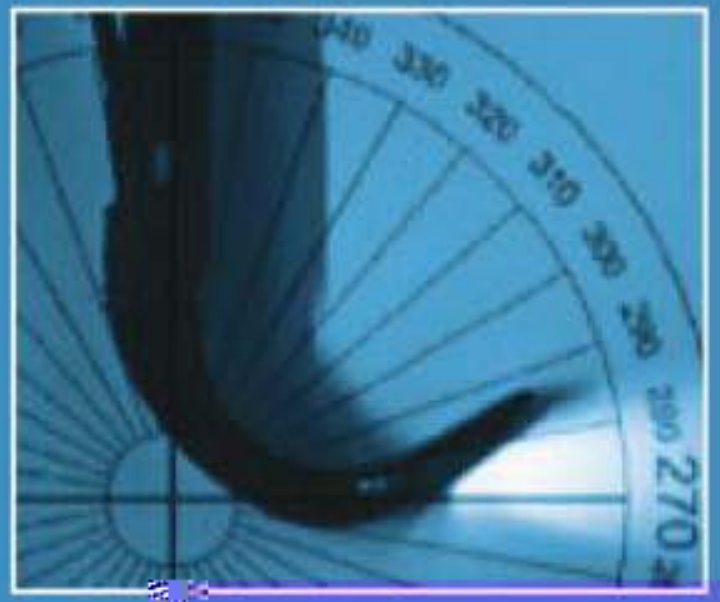


- TT railroaded over the bougie - When correctly placed in trachea, the bougie gets held at approx. 45 cm, making further advancement impossible

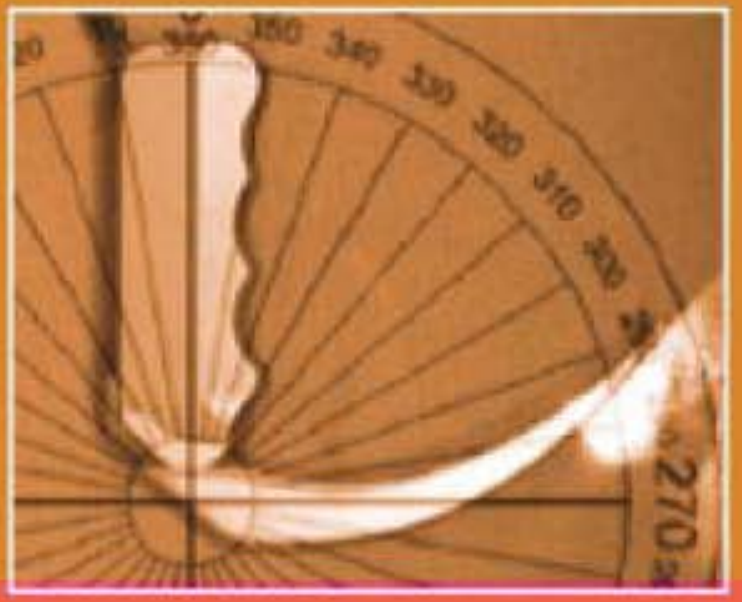
McGrath Videolaryngoscope



Glide Videolaryngoscope



C-MAC Videolaryngoscope



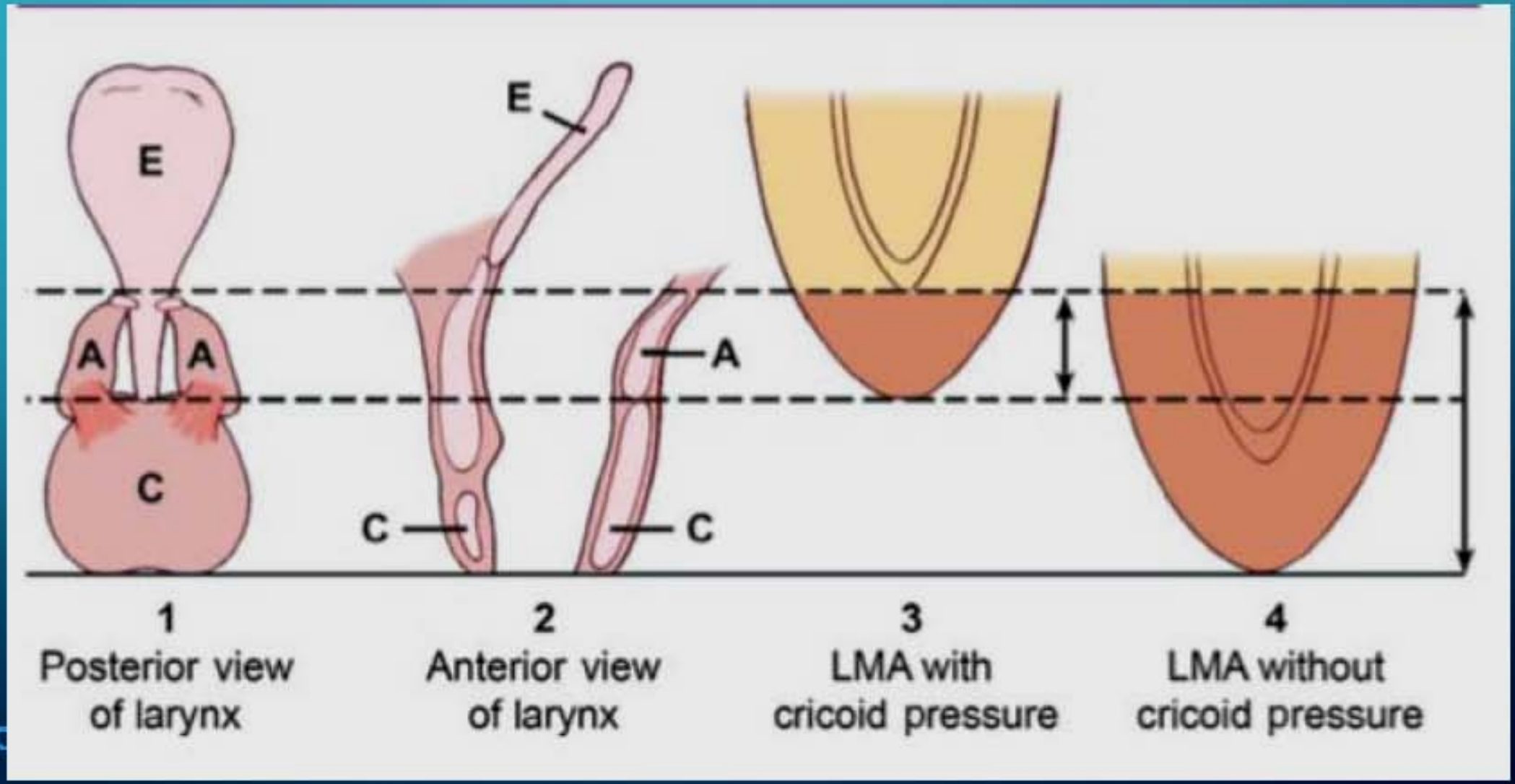
MAINTENANCE OF OXYGENATION/VENTILATION FAILED INTUBATION

- Providing maternal oxygenation
- preserving airway protection
- Prevention of gastric regurgitation and pulmonary aspiration
- While simultaneously allowing for delivery of the fetus

DIFFICULT VENTILATION/ OXYGENATION: USE OF A SUPRAGLOTTIC AIRWAY

- LMA Classic TM
- LMA Fastrach TM
- LMA Proseal TM
- LMA Supreme TM
- King LTS TM/LTS-D TM

LMA AND CRICOID PRESSURE



FIBERSCOPE/ AINTREE-GUIDED INTUBATION VIA LMA

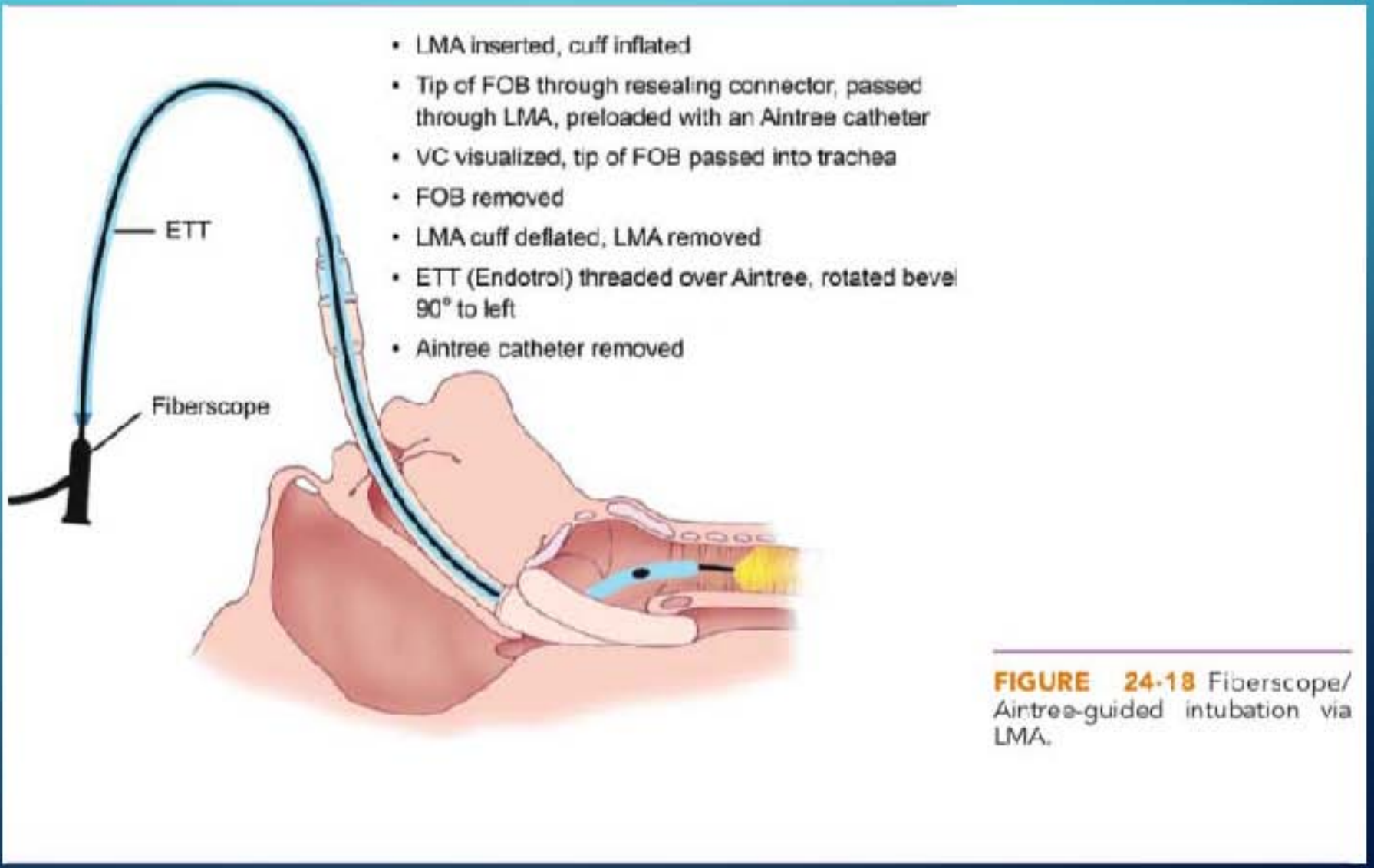
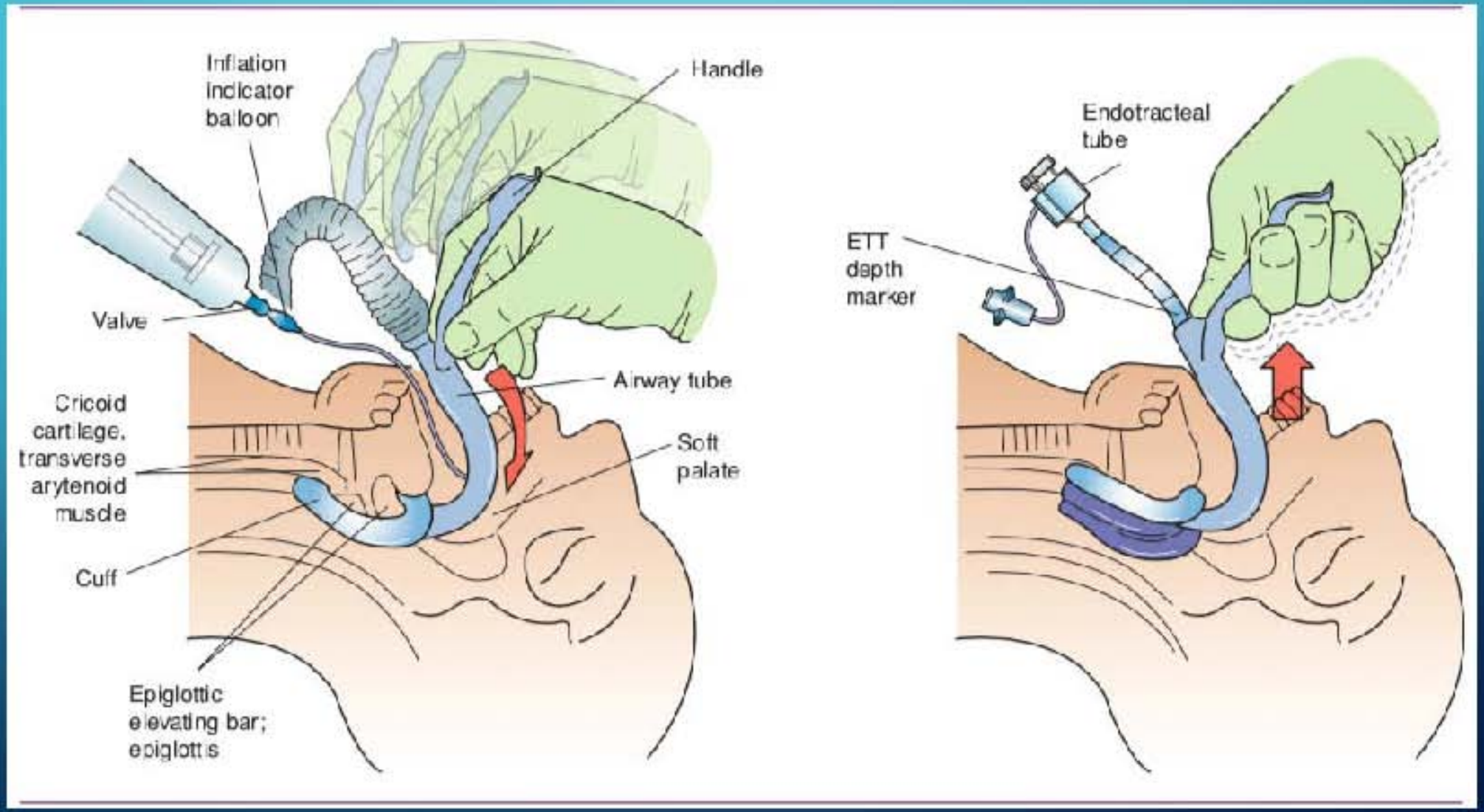


FIGURE 24-18 Fiberscope/ Aintree-guided intubation via LMA.

LMA -FASTRACH



TRACHEAL INTU- BATION VIA KING LTS-D USING AINTREE CATHETER AND FBERSCOPE

- King LTS-D inserted, cuff inflated
- Fiberscope, with preloaded Aintree catheter, inserted into trachea via King LTS-D
- Aintree catheter passed into trachea
- Fiberscope removed
- King LTS-D removed after cuff deflation
- ETT passed over Aintree catheter, bevel rotated 90° to left

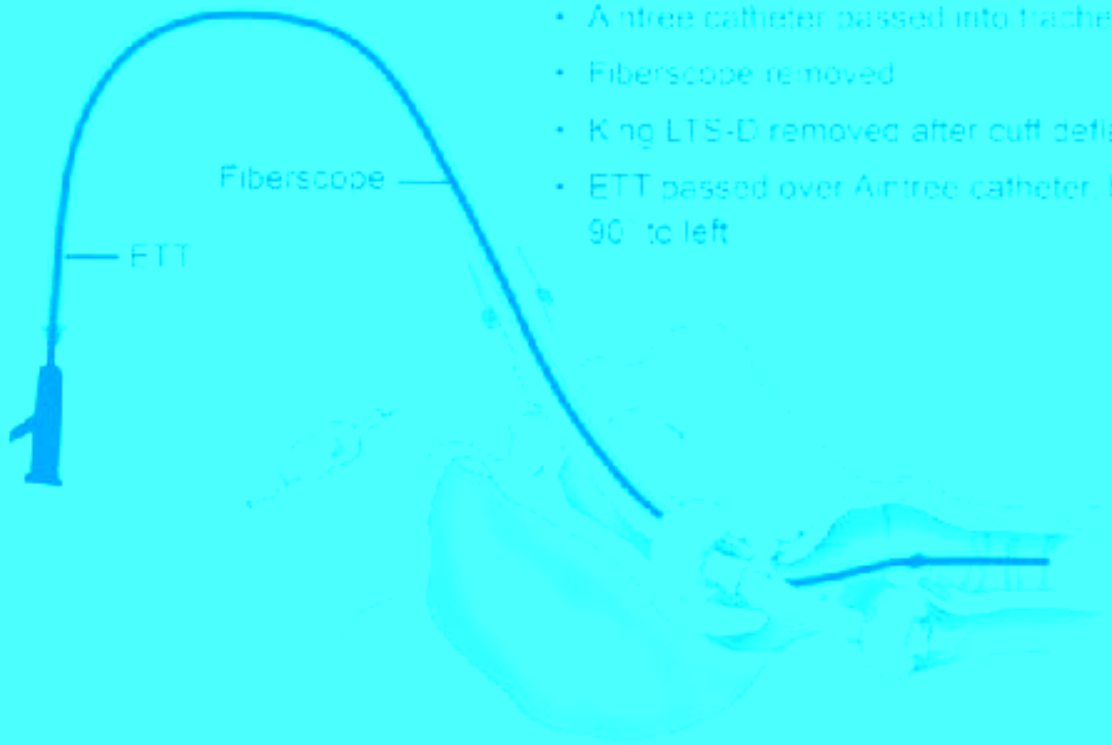


FIGURE 22.21 Tracheal intubation via King LTS-D using Aintree catheter and fiberscope.

INVASIVE AIRWAY TECHNIQUES

- Emergency Percutaneous Cricothyroidotomy
- Surgical Cricothyroidotomy
- Needle Cricothyroidotomy with Percutaneous Transtracheal Jet Ventilation (TTJV)
- Needle Cricothyroidotomy Using Seldinger Technique

FUTURE RECOMMENDATIONS FOR AIRWAY MANAGEMENT IN OBSTETRICS

- Maintenance of Certification in Anesthesiology (MOCA)

PULMONARY ASPIRATION

PATHOPHYSIOLOGY OF PULMONARY ASPIRATION OF GASTRIC CONTENTS

- Aspiration of solid material may cause death by asphyxiation
- Aspiration pneumonia is an infection of the respiratory tract caused by the inhalation of oropharyngeal material col- onized by organisms
- Aspiration pneumonitis is usually an acute lung injury (ALI)
- The aspirate induces a chemical burn , which results in an alveolar exudate composed of edema, albumin, fibrin, cellular debris, and red blood cells

PATHOPHYSIOLOGY OF PULMONARY ASPIRATION OF GASTRIC CONTENTS

- reduction in lung compliance with intrapulmonary shunting of blood
  - This results in hypoxemia and an increase in pulmonary vascular resistance
  - The inflammatory process may result in ALI or acute respiratory distress syndrome (ARDS)

MANAGEMENT OF ASPIRATION

- The tracheobronchial tree should be suctioned
- Bronchoscopy may be required to remove large particles of food
- Bronchoalveolar lavage is not recommended
- Prophylactic antibiotic therapy is not indicated in aspiration
- CPAP or protective ventilation strategies may be required while the lung injury resolves
- The routine use of corticosteroids are controversial

RISK FACTORS FOR PULMONARY ASPIRATION

- **"At-risk" Criteria for Pulmonary Aspiration**
- gastric material >25 mL at a pH <2.5
- Mendelson

STRATEGIES FOR PREVENTING PULMONARY ASPIRATION DURING OBSTETRIC SURGERY

- Preoperative Fasting
- Pharmacologic Prophylaxis

TABLE 25-1 Fasting Recommendations for Healthy Patients Undergoing Elective Procedures. The Fasting Periods Apply to Patients of all Ages Including Women Undergoing Elective Cesarean Delivery, But not to Women in Labor

Summary of Fasting	Recommendations
Clear liquids	2 h
Breast milk	4 h
Infant formula	6 h
Nonhuman milk	6 h
Light meal	6 h
Heavy meal	8 h (possibly longer) (fried/fatty foods, meat)

PHARMACOLOGIC PROPHYLAXIS

TABLE 25-2 Pharmacologic Prophylaxis Prior to Elective and Emergency Caesarean Delivery

	Oral Antacid	H_2-receptor Antagonist (Ranitidine)	Prokinetic Agents, e.g., Metoclopramide
Elective CS	No	150 mg on the night prior to and on the morning of surgery	10 mg on the night prior to and on the morning of surgery
Emergency CS	0.3 M Sodium citrate (30 mL) Prior to induction of general anesthesia *only*	Prior to surgery 50 mg IV	
High-risk labor	No	150 mg 6 hourly during labor	

ANY QUESTIONS