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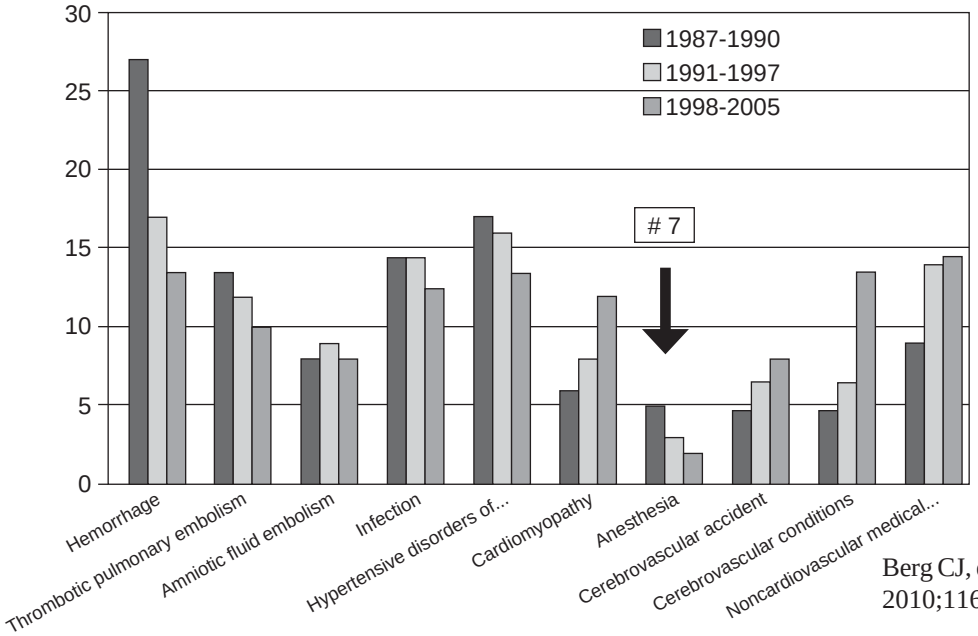
pp S254-S273

Avoiding airway catastrophes in obstetrical patients

I have no financial disclosures or conflict of interest

Maya S Suresh, MD

MATERNAL MORTALITY – UNITED STATES OF AMERICA



Berg CJ, et al. Obstet Gynecol 2010;116:1302-1309.

PREGNANCY-RELATED MORTALITY RATIO DUE TO ANESTHESIA IN THE UNITED STATES AND UNITED KINGDOM, 1979-2002

Triennium	United States*	United Kingdom†
1979-1981	4.3	8.7
1982-1984	3.3	7.2
1985-1987	2.3	1.9
1988-1990	1.7	1.7
1991-1993	1.4	3.5
1994-1996	1.1	0.5
1997-1999	1.2	1.4
2000-2002	1.0	3.0

* Maternal deaths per million live births.
† Maternal deaths per million maternities (live births, stillbirths, pregnancy terminations, ectopic pregnancies, and abortions).

Hawkins, et al. Anesthesia-Related Mortality in the United States. American College of Obstetricians and Gynecologists 2011;117(1):71.

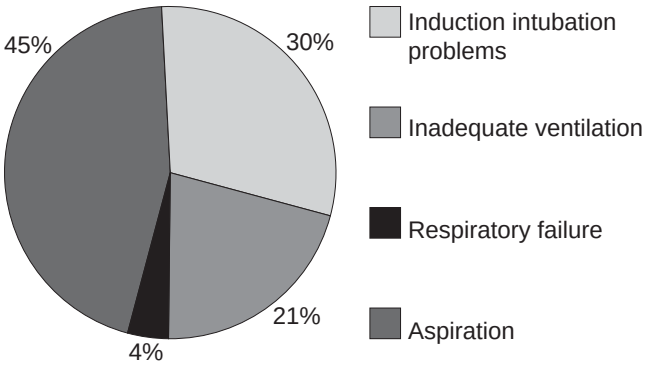
CASE FATALITY RATES AND RATE RATIOS OF ANESTHESIA-RELATED DEATHS DURING CESAREAN DELIVERY BY TYPE OF ANESTHESIA IN THE UNITED STATES, 1979-1990

Year of death	Case fatality rates* General anesthetic	Regional anesthetic	Rate ratios
1979-1984	**20.0**	**8.6**	**2.3 (95% CI 1.9-2.9)**
1985-1990	**32.3**	**1.9**	**16.7 (95% CI 12.9-21.8)**
1991-1996	16.8	2.5	6.7 (95% CI 3.0-14.9)
1997-2002	6.5	3.8	1.7 (95% C 0.6-4.6)

CI, confidence interval
* Deaths per million general or regional anesthetics

Hawkins, et al. Obstet Gynecol 2011;117:69-74.

Anesthesia - related mortality 1979-1990
1979-1990
General anesthesia (n = 67)
82% deaths during C/D



Hawkins, et al. Anesthesiology, 1997;86:277-84.

CASE FATALITY RATES AND RATE RATIOS OF ANESTHESIA-RELATED DEATHS DURING CESAREAN DELIVERY (C/D) BY TYPE OF ANESTHESIA IN THE UNITED STATES, 1991-2002

Year of death	Case fatality rates* General anesthetic	Regional anesthetic	Rate ratios
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CI, confidence interval
* Deaths per million general or regional anesthetics

Hawkins, et al. Obstet Gynecol 2011;117:69-74.

1991-2002 Deaths from general & regional anesthesia (n = 56)

Total deaths -56 (86% during C/D)

Overall *leading causes* of death:
- Intubation failure
- Induction problems
- High spinal/epidural

Hawkins, et al. Anesthesiology 1997;86:277-84.

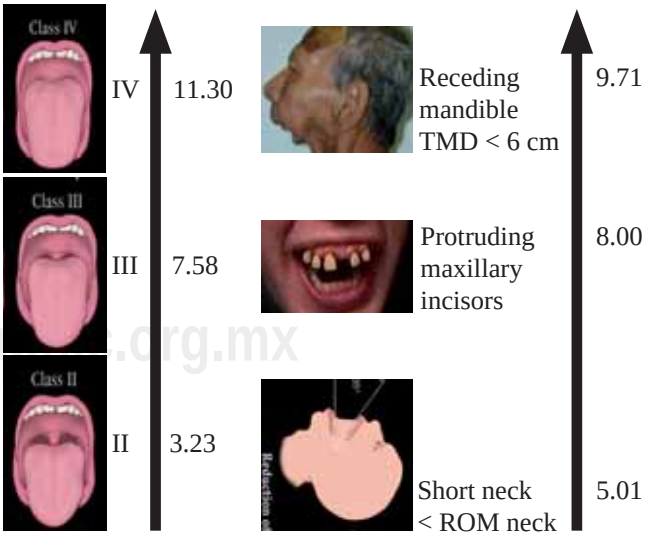
FAILED INTUBATION TIME AND URGENCY OF OPERATION

	Time of operation	Cesarean sections	Failed intubations
	Day (08:00-17:00)	85%	22%
	Evening (17:00-21:00)	4%	9%
→	Night (21:00-08:00) Plus weekend	12%	69%
	Urgency of operation		
	Elective	56%	9%
→	Emergent	44%	91%

Hawthorne L. Failed intubation revisited: 17-yr experience in a teaching maternity unit. BJA 1996;77(5):680-4.

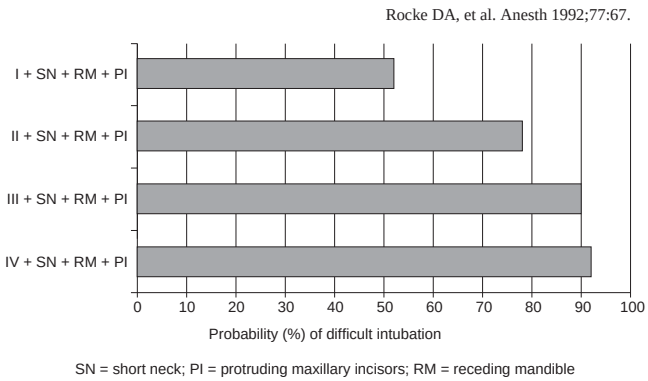
RELATIVE RISK FACTORS ASSOCIATED WITH DIFFICULT TRACHEAL INTUBATION IN OBSTETRICS: COMPARED WITH MALLAMPATI CLASS I AIRWAY

Mallampati class



Rocke DA, et al. Anesth 1992;77:67-73.

PROBABILITY OF EXPERIENCING DIFFICULT INTUBATION FOR VARYING COMBINATIONS OF RISK FACTORS



SN = short neck; PI = protruding maxillary incisors; RM = receding mandible

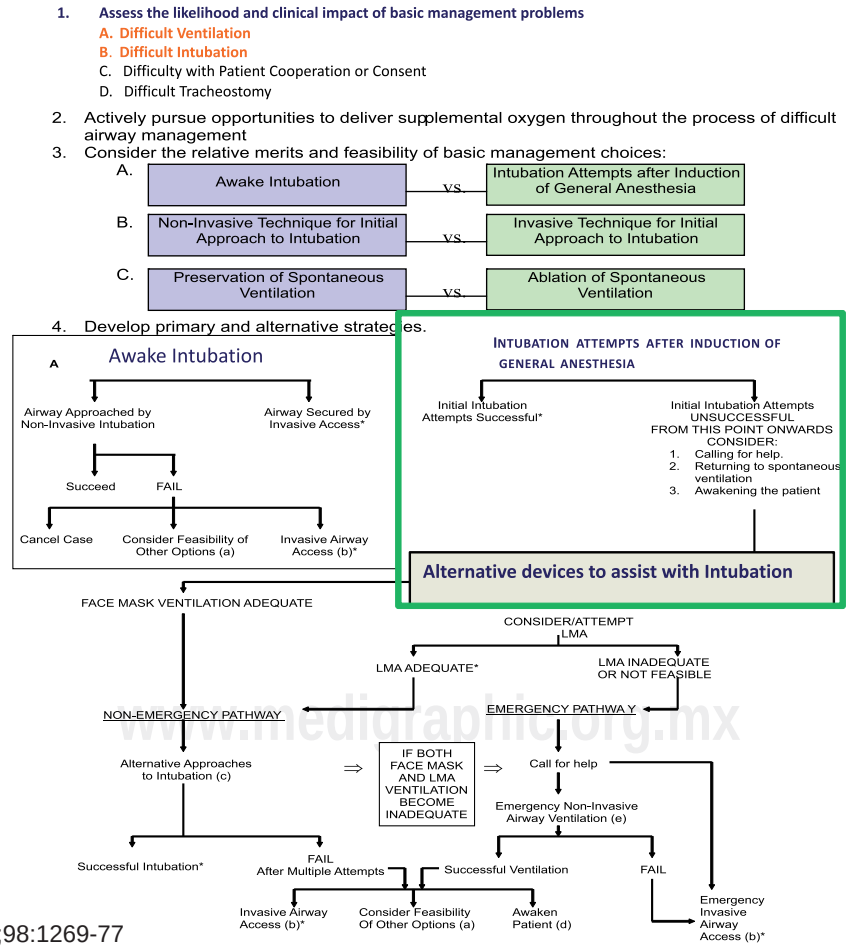
CASE

- A patient scheduled for urgent C/S for non-reassuring FHR, stated almost died after «pain meds» during previous surgery. Following prep and antibiotics plan was to administer spinal without narcotics. Patient had anaphylactic reaction to antibiotics facial swelling
- Stat C/S due to FHR deceleration
- Induction of GA, first attempt grade IV laryngoscopic view,

- Second attempt Grade III view

HOW WOULD YOU PROCEED?

ASA DIFFICULT AIRWAY ALGORITHM



Anesthesiology 2003;98:1269-77

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

Step 1. First tracheal intubation
- G.I. prophylaxis, LUD, Pre-oxygenation, RSI
- **Sniffing position (Morbidly obese-ramp position)**
- Cricoid pressure: 10N awake, 30N anesthetized
- **External laryngeal manipulation (BURP maneuver)**

↓ Difficult laryngoscopy / Difficult intubation

→ Direct laryngoscopy

Successful tracheal intubation →
- Verify intubation by capnography
- Proceed with cesarean delivery

→
- **Call for help**
- **Call for difficult airway cart**
- Consider awakening the patient
- Return to spontaneous ventilation

Step 2. Second tracheal intubation
- Maintain 30N cricoid pressure
- Maintain oxygenation and ventilation with face mask
- Assess laryngoscopic view
- External laryngeal manipulation (BURP maneuver)

↓ Failed / Intubation

* Not more than 2 attempts at intubation

Poor view →

Alternative devices

- Reduce cricoid pressure
- Gr. 3A – Eschmann bougie assisted intubation
- Gr. 3B/4 – Optical stylet assisted intubation
- Gr. 3B/4 – Videolaryngoscopy assisted intubation

Successful tracheal intubation →
- Verify intubation by capnography
- Proceed with cesarean delivery

Step 3. Maintenance of oxygenation/ventilation
- Face mask ventilation (MV)
- Two-person mask ventilation

↓ Difficult Ventilation

* Non emergency pathway

Unsuccessful MV →

Supraglottic airway

- LMA™
- Confirm ventilation, oxygenation, anesthesia, CVS stability and muscle relaxation
- Attempt tracheal intubation via LMA™ (blind or fiberoptic assisted)

Successful tracheal intubation →
- Verify intubation by capnography
- Proceed with cesarean delivery

Unsuccessful tracheal intubation - - - →
- Maintain cricoid force, 30N
- Communicate with obstetrician
- Avoid exteriorization of uterus
- Avoid fundal pressure during delivery
- Proceed with delivery of fetus

Step 4. «CICV» Scenario Non-invasive Rescue ventilation

↓ Failed / Ventilation

* Emergency pathway

CICV →

Non-invasive alternative devices

- Combitube™
- King LTS™/LTS-D™

Successful tracheal intubation →
- Confirm oxygenation, anesthesia, CVS stability
- Proceed with cesarean delivery

Step 5. «CICV» Scenario Increasing hypoxemia Invasive rescue ventilation

* Emergency pathway critical airway

CICV/ Hypoxemia →

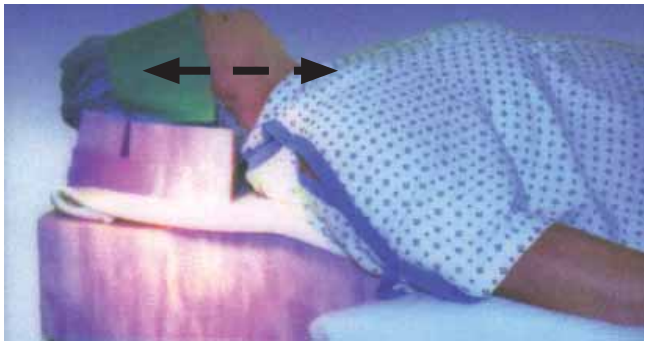
Invasive airway access

- Cricothyroidotomy
- Transtracheal jet ventilation

Successful ventilation →
- Confirm oxygenation, anesthesia, CVS stability
- Proceed with cesarean delivery

* Note: Steps 1 through 5 should be time-limited, no more than 30-45 sec per step (total ≤ 5 min)

PROPER POSITIONING FOR LARYNGOSCOPY MORBID OBESITY AND BURP MANEUVER



Std. Pillow Plus Elevation Pillow

An imaginary horizontal line should connect the patient's sternal notch with the external auditory meatus

Brodsky JB, et al. Anesth Analg 2003;96:1841.

BURP (BACKWARD, UPWARD, AND RIGHT) MANEUVER

Difficult laryngoscopy made easy with BURP Maneuver optimal external laryngeal manipulation

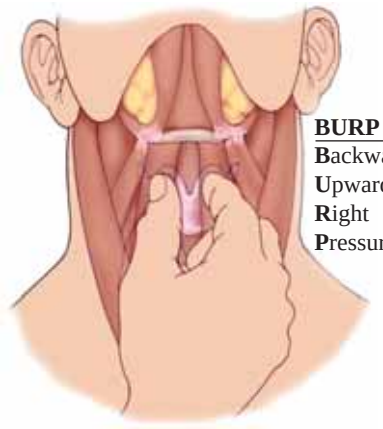
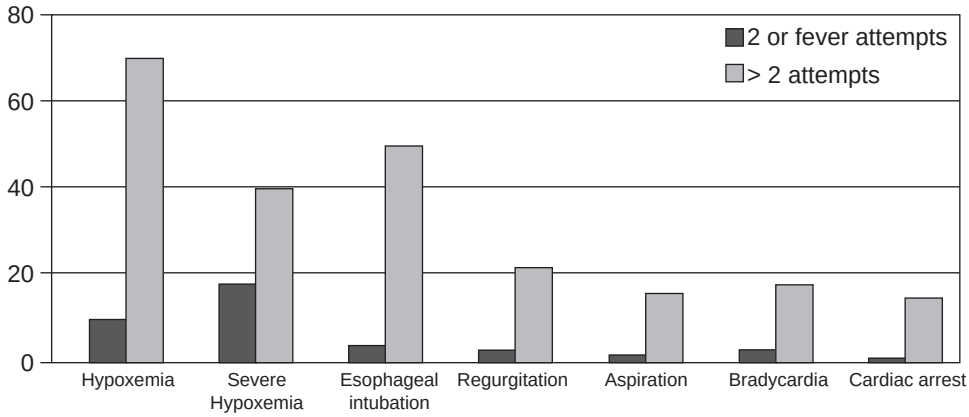


Figure 13. Difficult laryngoscopy made easy with BURP maneuver. Knill, 1993. Canadian J of Anaesthesia 1993;V40(3):279-282.

GRAPHIC DISPLAY OF COMPLICATIONS BY INTUBATION ATTEMPTS



Mort TC: Tracheal Intubation : Complications associated with repeated laryngoscopic attempts Anesth Analg 2004;99:607-13.

EFFICACY OF AIRWAY DEVICES

- The relative efficacy of airway devices in obstetrics has not been studied
- The use of appropriateness of devices in the ASA algorithm in obstetrics has not been studied
  - Appropriate device during difficult laryngoscopy
  - Alternative devices for Intubation
  - Appropriate device to assist with ventilation
  - Appropriate device to assist with difficult ventilation & prevention of aspiration
  - Appropriate device in a cannot intubate/cannot ventilate situation

- Use of airway devices during failed intubation in obstetrics have been in the form case reports

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↓ Failed
↓ Intubation

***Not more than 2 attempts at intubation**

Poor view →
Alternative devices

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↓ Failed
↓ Ventilation

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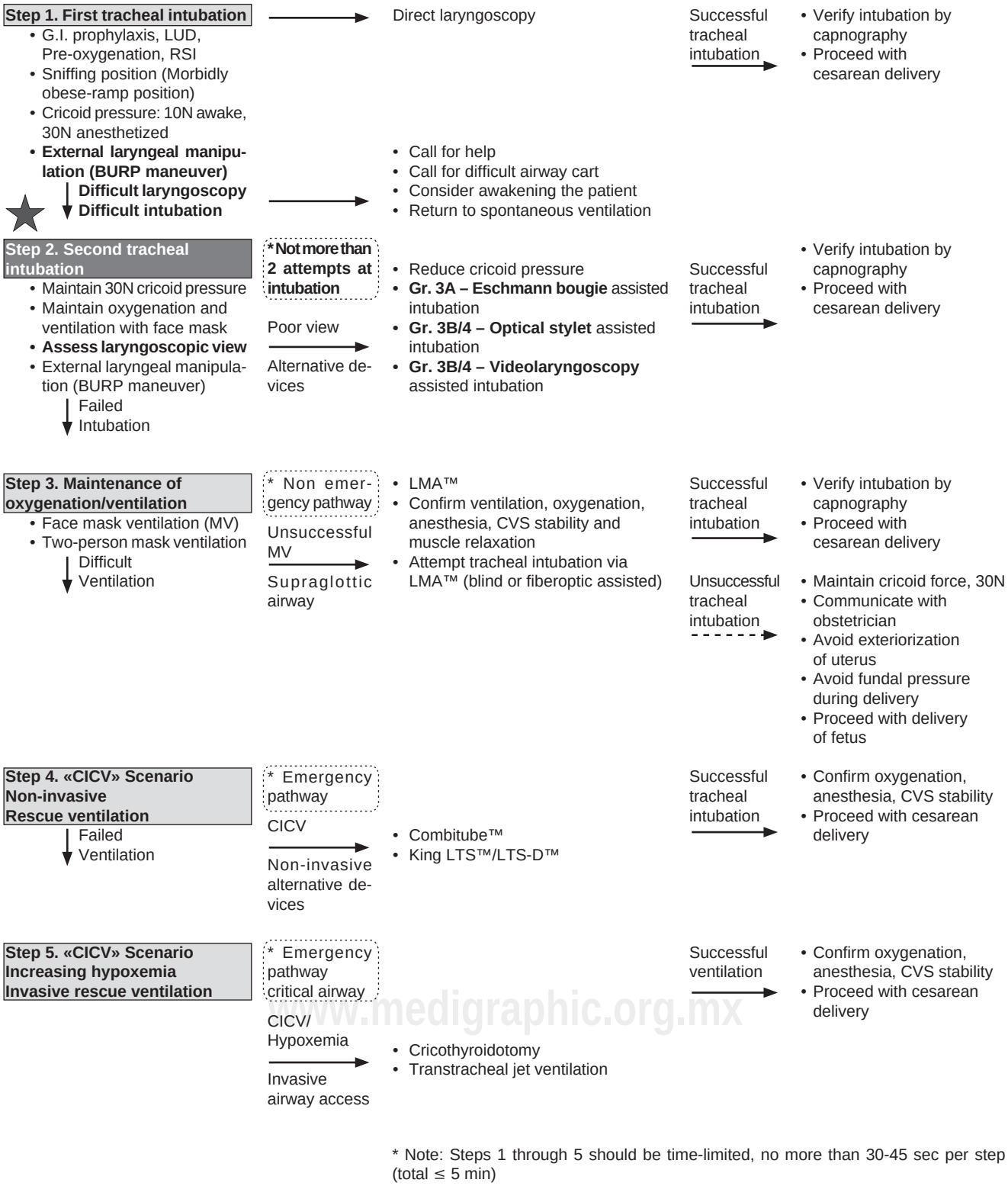

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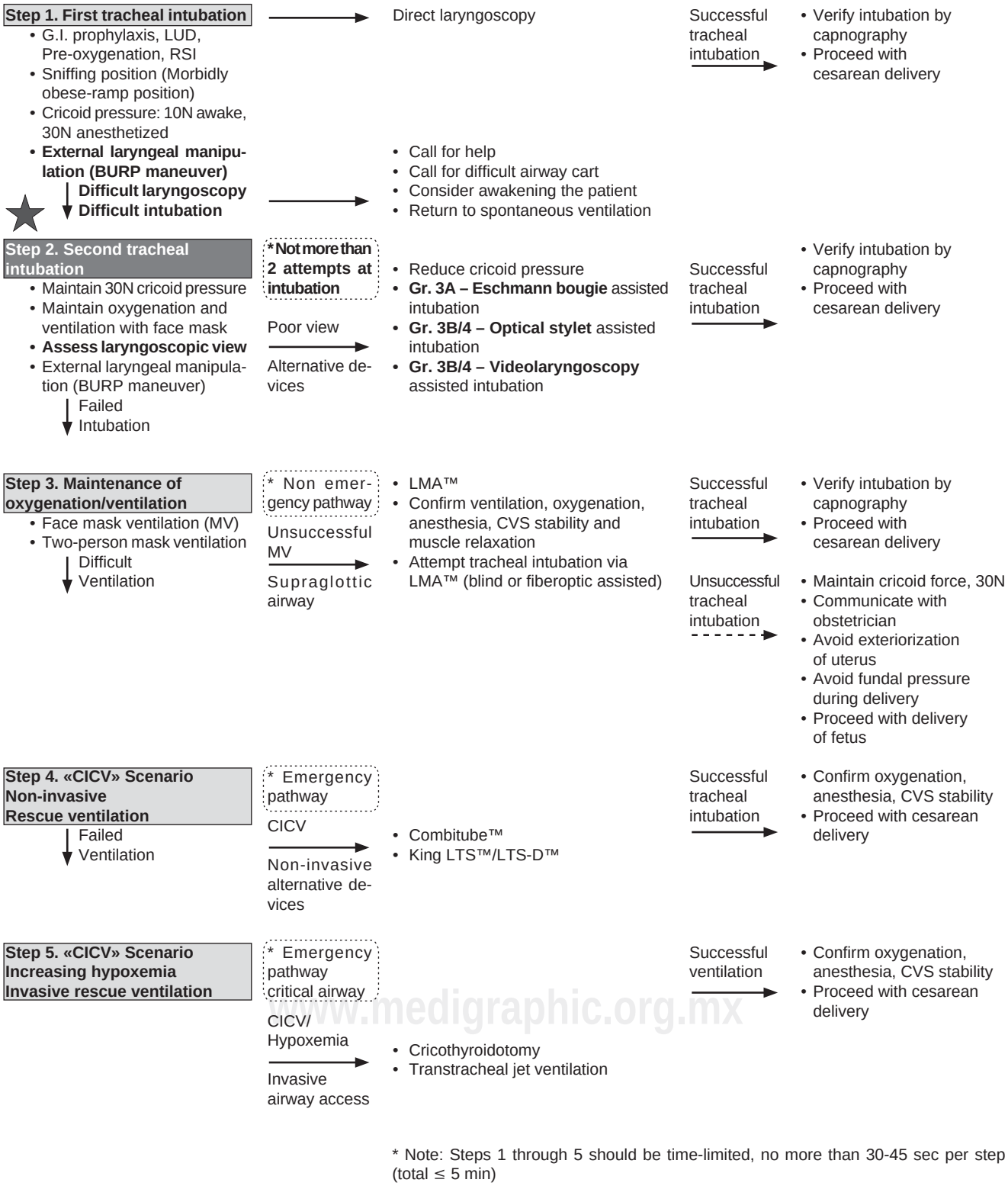

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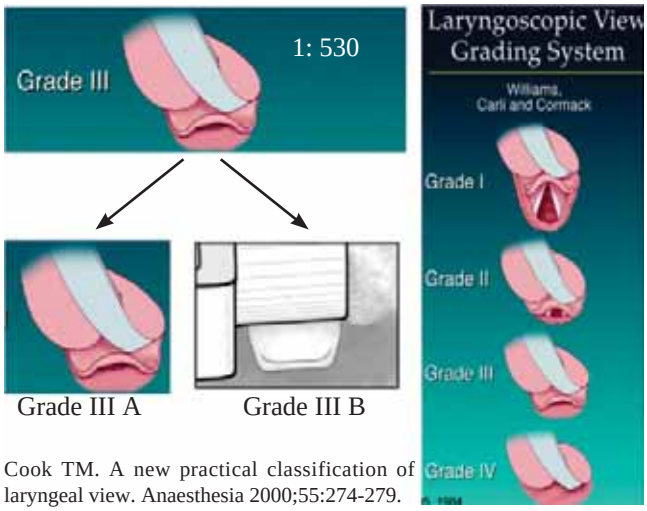
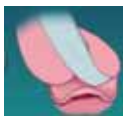
CLASSIFICATION OF CORMACK LEHANE GRADE III LARYNGOSCOPIC VIEW

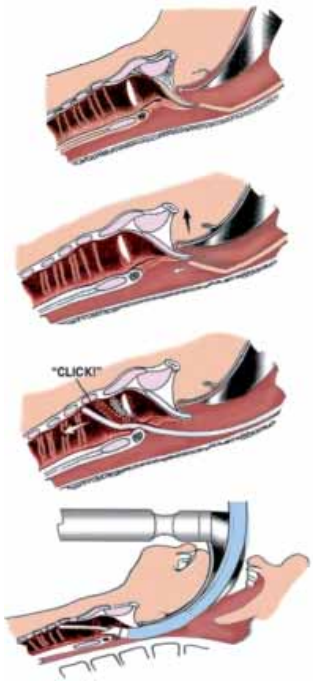


Cook TM. A new practical classification of laryngeal view. Anaesthesia 2000;55:274-279.

ESCHMANN BOUGIE GUIDED TRACHEAL INTUBATION

Grade IIIA





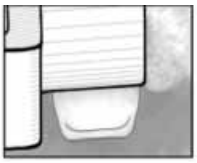
- Distal 3 cm is angulated 35°, tip should be introduced pointing anteriorly
- Tip of Eschmann Bougie passes under the epiglottis
- When passing through the trachea, the tip vibrates or tracheal ring clicks are felt
- TT railroaded over the bougie –When correctly placed in trachea, the bougie gests held at approx. 45 cm, making further advancement impossible

Figure 15. Eschmann bougie guided tracheal intubation. Kidd JF. Anaesthesia 1988;43(6):437-438.

EFFICACY OF FIBEROPTIC OPTICAL STYLET: FAILED FIRST ATTEMPT AT INTUBATION

Grade III A

Grade III B



- Fiberoptic optical stylet
  - Offered by multiple manufacturers –Shikani seeing optical stylet, Levitan, Airview
  - Used as adjunct to laryngoscopy the tip of the loaded stylet is placed just beneath the tip of the epiglottis under direct vision
    - More useful in Grade III B view

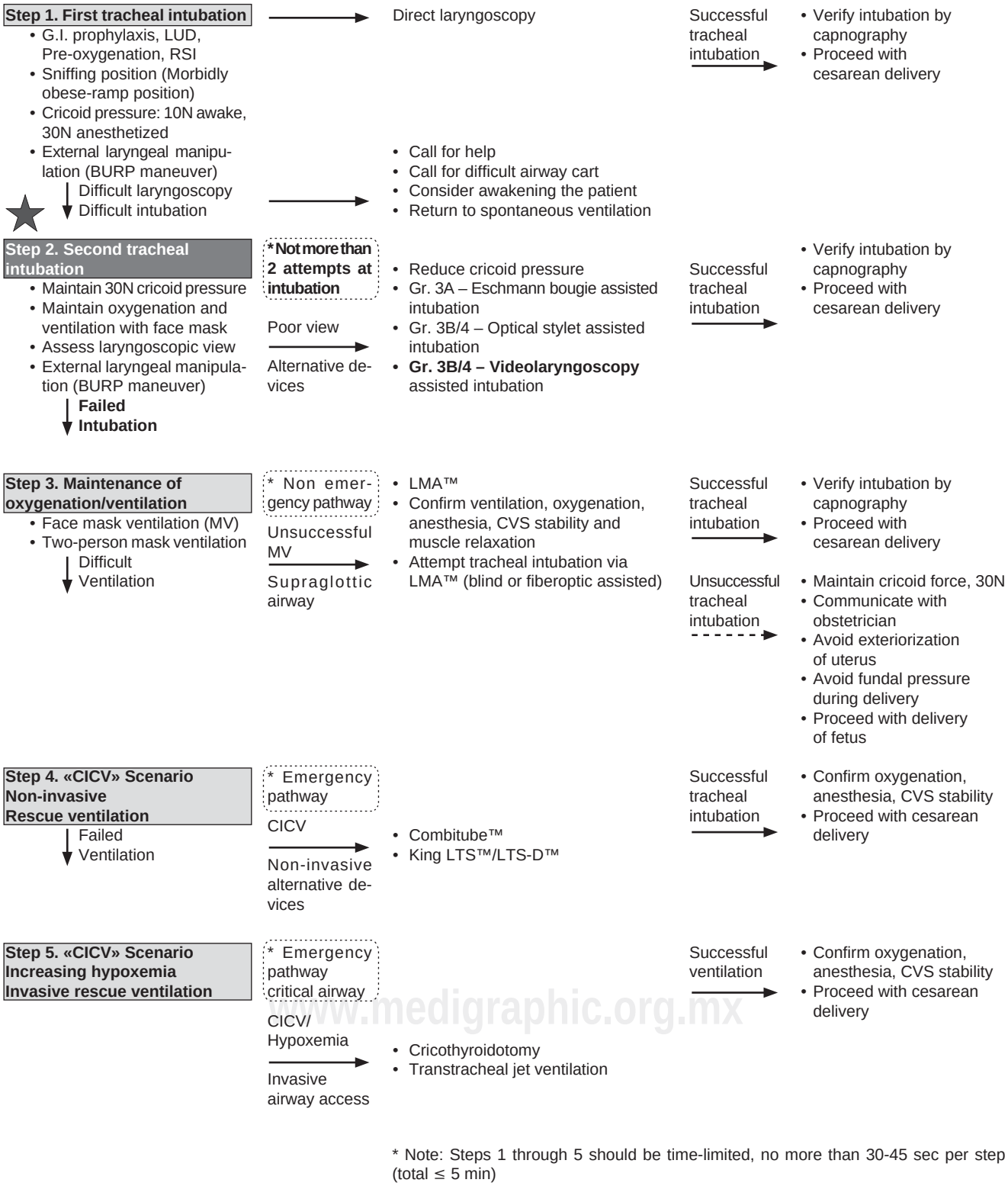
MEAN TIMES TO SUCCESSFUL TRACHEAL INTUBATIONS AND PROPORTIONS OF SUCCESSFUL TRACHEAL INTUBATIONS

Laryngoscopy view	Eschmann ETT introducer N = 103	Fiberoptic optical Stylet N = 103	Difference (95% CI)
Grade III A			
Mean time to success, s*	31	29.2	1.8 (-2.5 to 6.1)
Success rate	103 (100%)†	101 (98%)†	2 (-0.7 to 4.6)
First attempt success	102 (99%)†	93 (90%)†	9 (2.7 to 14.7)
Grade III B			
Mean time to success, s*	45.6	31	14.6 (-2.3 to 31.5)
Success rate	9 (9%)†	101 (98%)†	-92 (-95.4 to -83.3)
First attempt success	6 (6%)†	90 (87%)†	-84 (-89.4 to -73.7)

* Observations were excluded for participants with 2 failed attempts before calculation

Fiberoptic Stylet *vs* Bougie for laryngoscopy; Kovacs et al. Annals of Emergency Medicine V50,#6: Dec 2007 676-85

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



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FIBEROPTIC OPTICAL STYLET PLACEMENT

CASE

- Optical stylet (Levitan) assisted intubation
  - Anaphylaxis to antibiotic –Stat C/S swollen airway-Grade IV laryngoscopic view, failed intubation followed by Levitan –assisted intubation
  - Stat C/S failed intubation, Grade IV laryngoscopic view, rescued by Levitan –assisted intubation

ALTERNATIVE DEVICES TO INTUBATION VIDEO LARYNGOSCOPE

Glide Scope video laryngoscope

Storz video laryngoscope

McGrath video laryngoscope

Airtraq

Pentax

King vision

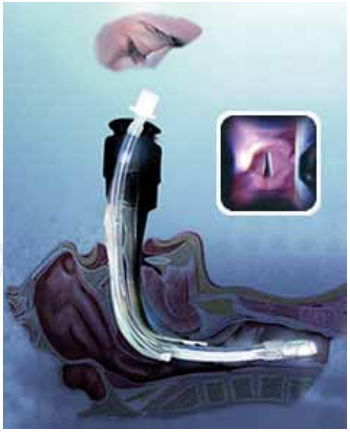
CASE SERIES OF SUCCESSFUL VIDEOLARYNGOSCOPIC INTUBATION IN OBSTETRIC PATIENTS GLOTTIC VIEW AT INTUBATION

- 27 patients requiring general anesthesia were intubation successfully with videolaryngoscope
- **An improved C&L view with VL was clearly evident – 100% grade I view**
- All 27 parturients intubated successfully with VL
- VL shown to be superior to conventional laryngoscopy

	C+L 1	C+L 2	C+L 3
Standard view	14 (52)	12 (44)	1 (4)
Videolaryngoscope view	27 (100)	0 (0)	9 (0)

VIDEO - ASSISTED TRACHEAL INTUBATION AIRTRAQ IN OBSTETRICS- CASE REPORT

- New disposable intubating laryngoscope
- Designed to provide a view of the glottis without alignment of oral, pharyngeal, and tracheal axis
- *Case report:* Report of two cases of rapid tracheal intubation with Airtraq laryngoscope in morbidly obese parturients undergoing emergency cesarean delivery



Dhonneur G. Anesthesiology 2007;106:629-30.

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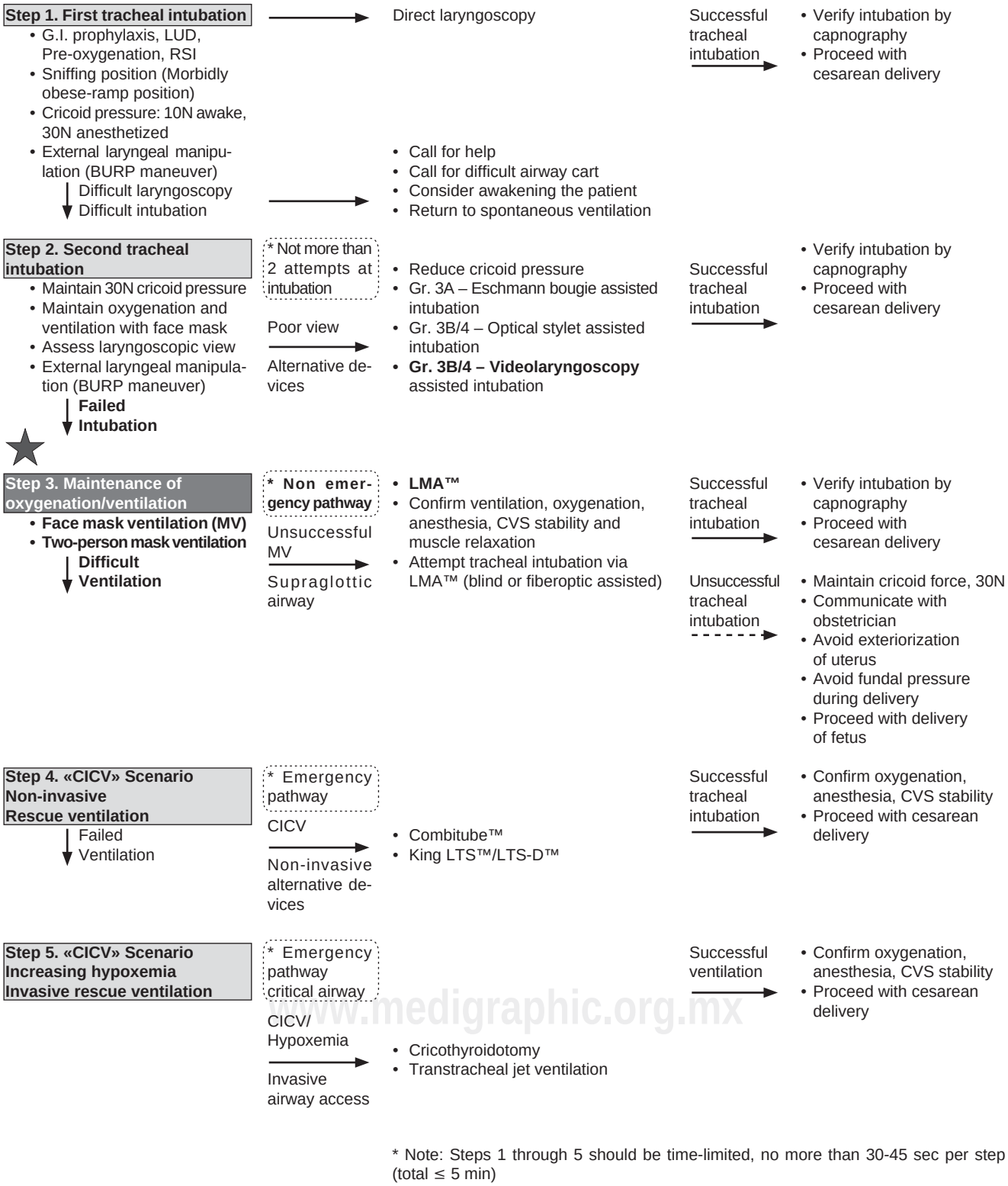

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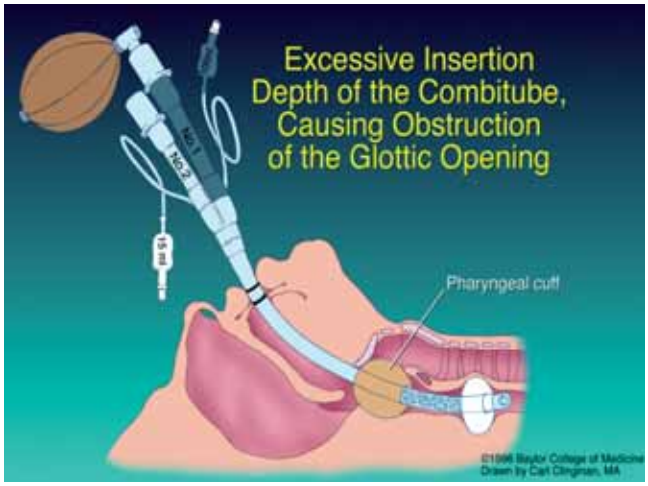
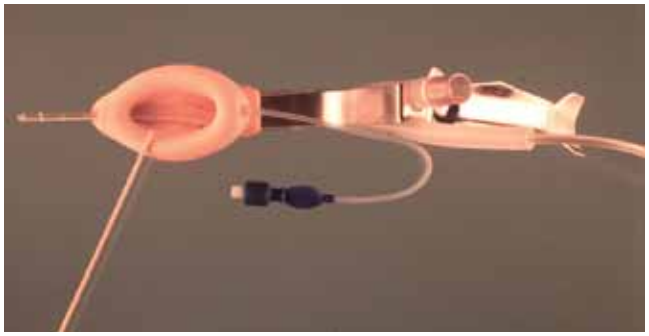
ADDITIONAL REPORTS: USE OF INTUBATING LMA IN OBSTETRICS

- ILMA /FASTRACH ™ has been used in parturients after failed intubation
  - Gonzales: Rev Esp Anesthesiol Reanim 2005;52(1):56-57
  - Miniville Anesth Analg 2004;99(6):1873
- ILMA life- saving rescue device in our institution
  - Eclamptic patient for stat C/S
  - Failed regional block/GA and Failed Intubation
  - Failed intubation/Stat C/S Fetal Distress
  - Failed intubation/failed bougie

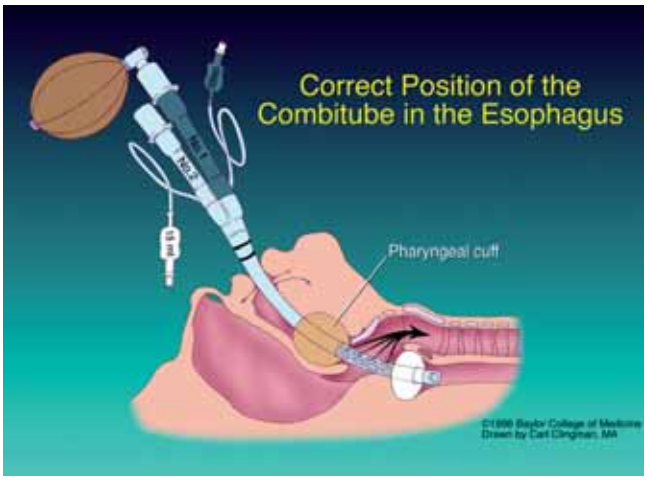
USE OF COMBITUBE IN OBSTETRICS DIFFICULT AIRWAY



CASE REPORTS IN OBSTETRICS: PROSEAL LMA: FAILED INTUBATION – C/S

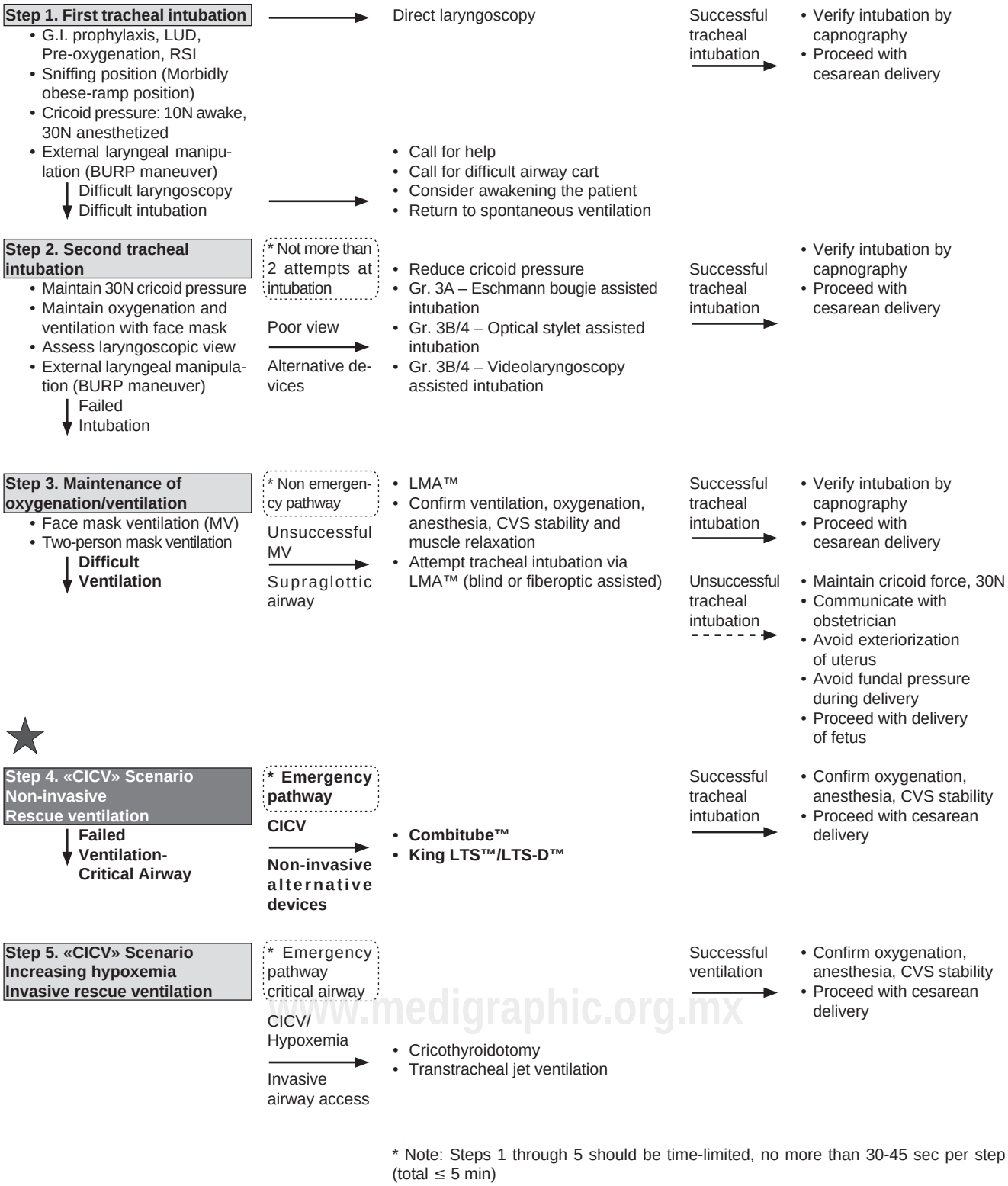


- Use of a ProSeal LMA for airway maintenance during emergency caesarean section after failed tracheal intubation. Awan R, Nolan JP, Cook TM. Brit J Anaes 2004;92:144.
- Failed obstetric tracheal intubation and postoperative respiratory support with the ProSeal LMA, Keller C, Brimacombe J et al Anesth Analg 2004;98:1467-70.
- Use of the ProSeal LMA for airway maintenance during emergency C/S after failed intubation. Bullingham et al. BJA 2004;92:903-904.
- Another case of use of the ProSeal LMA in a difficult obstetric airway. Vaida SJ et al. BJA 2004;92:905.
- The ProSeal LMA in failed obstetric tracheal intubation. Bailey et al. IJOA 2005;14:270-271.
- The ProSeal LMA in two failed obstetric tracheal intubation scenarios. Sharma B et al. IJOA 2006;V15(4):338-339.



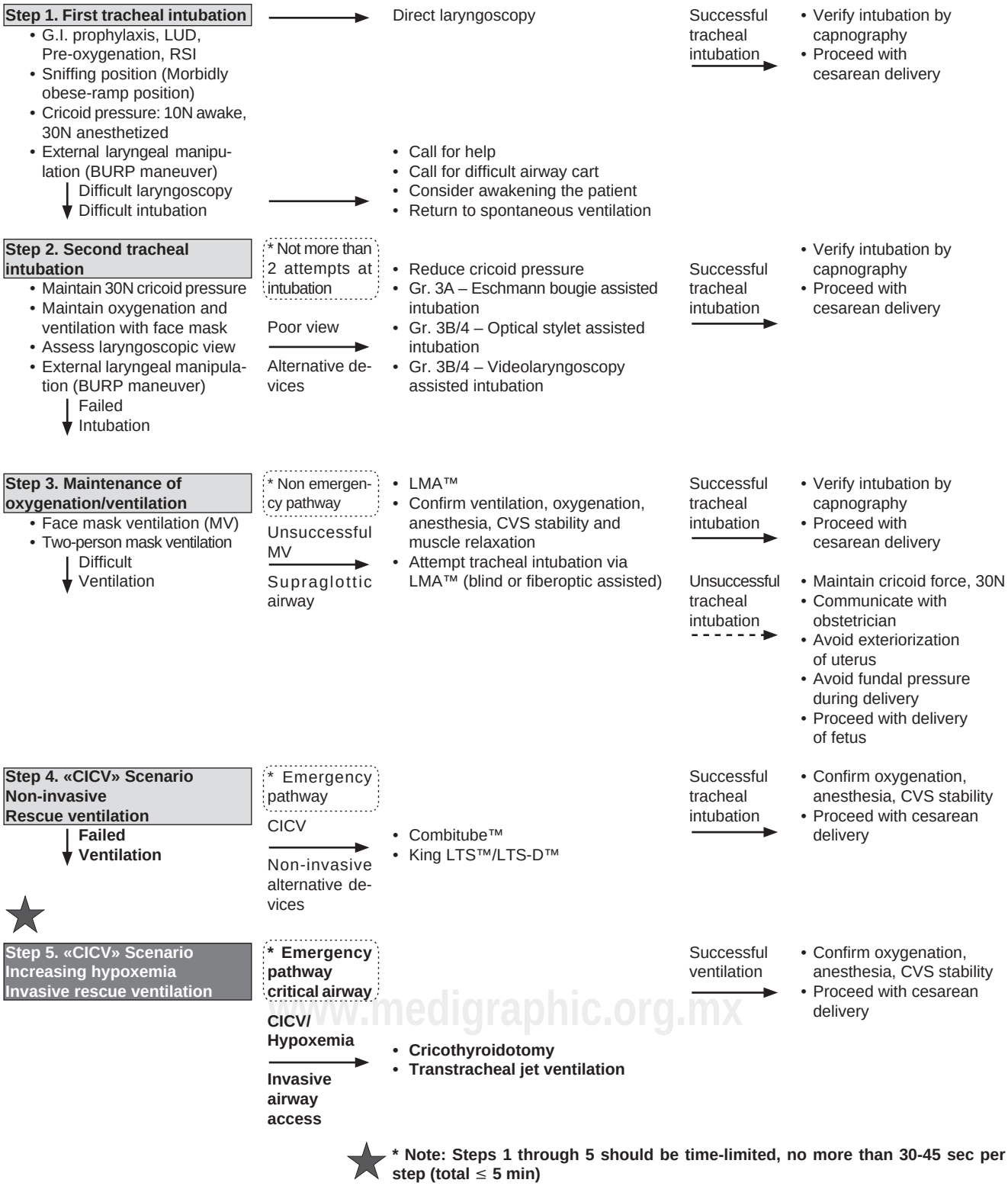
- Unanticipated DA-Several case reports-successful use of ETC (bull neck, lockjaw, difficult anatomy)
  - Eur Arch Otorrhinol 1991;248:129-31
  - Br J Anes 1992;68:534-5
  - Anaes Intensiv Notfallmed Schmerz 1996;31:191-3
  - Eur J Anaesthesiol 1995;12:189-193
  - J Anesth 1994;8:233
- Massive bleeding or regurgitation
- Obstetrics
  - Case reports. Difficult airway 2001;2:78-83
- Burn Injury
  - J of Clinical Anesthesia 15;2002

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

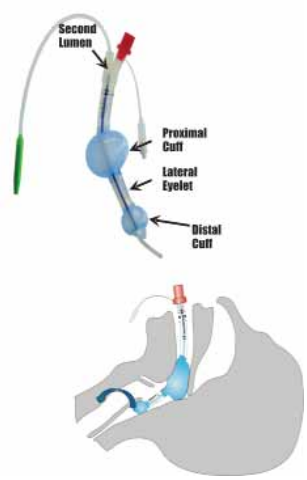


* Note: Steps 1 through 5 should be time-limited, no more than 30-45 sec per step (total ≤ 5 min)

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



LARYNGEAL TUBE – S ™
Case report



- Successful use of laryngeal tube –S™ for airway management and prevention of aspiration after a failed tracheal intubation in a parturient

Ref: Zand, Farid, Amin, Asfin Anesthesiology 2005;102(2):481-483.

CICV: CRITICAL AIRWAY

- Incidence of failed intubation – CICV 1:536
- 39 y.o., multiparous woman, TIUP, breech presentation, presented to L&D in active labor .Scheduled for C/S. MP Class II airway
- Multiple failed attempts at spinal anesthetic
- Proceeded with RSI induction
- Five attempts at intubation-failed
- Unsuccessful mask ventilation
- Failed combitube placement
- Unsuccessful cricothyroidotomy (by Obstetrician)
- Cardiopulmonary arrest
- Surgical tracheostomy completed after arrest
- Cardiac resuscitation accomplished, rhythm restored
- Mother remained in coma till death (7 days)
- Baby delivered – severe cerebral palsy

Tsen LC, Pitner R, Camann WR. GA for C/S at a tertiary care hospital (Academic Center). International Journal of Obstetric Anesthesia 1998;7:147-152.

AIRWAY, MORBIDITY AND MANAGEMENT 2000-2005

- Six year study period 2000-2005
- 98 parturients received GA
- A sentinel event of difficult intubation (HELLP syndrome)
- MP class III airway
- Three attempts at intubation –severe contact bleeding
- Initial placement of LMA complicated by laryngospasm
- Cannot intubate /cannot ventilate situation –resulting in an airway code
- Successful cricothyroidotomy (Induction to establishment of airway, 5 min)
- Five days later decannulation; DL revealed MP Class I

Palanisamy A. General anesthesia for cesarean delivery at a tertiary hospital from 2000 to 2005: a retrospective analysis & 10 year update
International Journal of Obstetric Anesthesia 2011;20:10-16.

AIRWAY CATASTROPHES DURING EMERGENCE & EXTUBATION

ASA TASK FORCE ON DIFFICULT AIRWAY MANAGEMENT: EXTUBATION STRATEGY

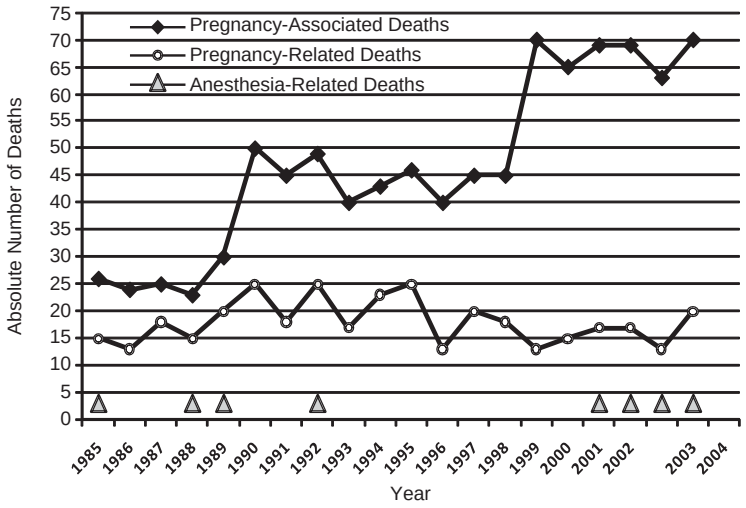
- The ASA task force on the management of the difficult airway regards the concept of extubation strategy as a logical extension of the intubation process
- Tracheal intubation receives much attention, especially with regard to management of the difficult airway
  - Very little emphasis on strategy and research on complications following tracheal extubation and emergence issues in PACU
  - In both in the **general and obstetrical patients**

ANESTHESIA-RELATED MATERNAL DEATHS IN POSTOPERATIVE PERIOD MICHIGAN: 1985-2003

- Anesthesia-related deaths occurred postoperatively:
  - During emergence and post anesthesia recovery not during induction of general anesthesia
  - Airway obstruction and hypoventilation
- System-errors emerged:
  - Lapses in postoperative monitoring
  - Inadequate supervision by an anesthesiologist
- Important risk factors:
  - Obesity
  - African –American race
  - Important risk factors for anesthesia –related mortality

Mhyre JM, Riesner MN, Polley LS, Laughton NN: A series of anesthesia –related maternal deaths in Michigan 1985-2003. Anesthesiology 2007;106:1096-1104

A Series of Anesthesia - related Maternal Deaths in Michigan 1985-2003

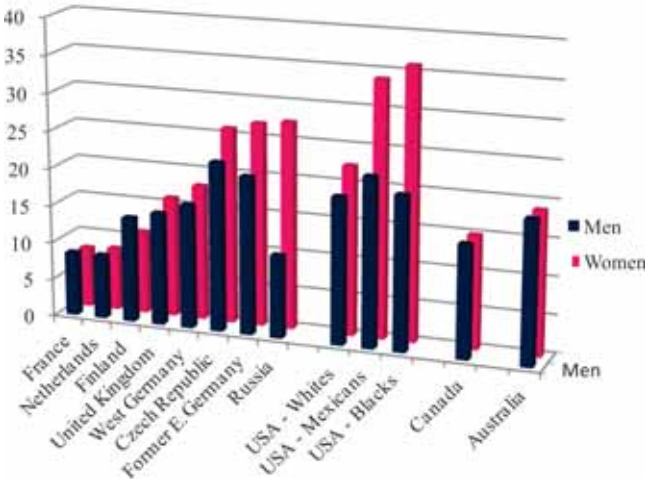


Patient	Maternal Condition	BMI, kg/m²	Race	Procedure (Urgency)	Anesthesia Type, Airway Management; Postoperative Care	Most likely Complication of Anesthesia; Presentation	a) Immediate Cause of Death b) Time of Death if Delayed c) Autopsy Findings
1	Term pregnancy with NRFHT*; refused spinal anesthesia	33	Black	Cesarean delivery (emergent for NRFHT)	GA; ETT	**Airway obstruction**; CP arrest during emergence from GA	a) CP arrest, failed resuscitation
2	24-week spontaneous vaginal stillbirth of twins; retained placenta	37	Black	Dilation and curettage (emergent for hemorrhage)	GA; ETTextubated before transfer to PACU	**Hypoventilation or airway obstruction**; 25 min after arrival in PACU, patient found to be apneic and bradycardic	a) CP arrest, failed resuscitation
3	Undesired pregnancy in the first trimester	29	Black	Vacuum aspiration (elective)	Deep sedation; SV	**Hypoventilation** airway obstruction; 25 min after arrival in PACU, patient found to be pulseless and apneic	a) CP arrest, failed resuscitation
4	Term pregnancy with chronic hypertension, polysubstance abuse	32	Black	Cesarean delivery (elective repeat)	Spinal	**Hypoventilation** or airway obstruction; apneic and bradycardic on arrival PACU	a) CP arrest, failed resuscitation c) Dilated cardiomyopathy; toxicology positive for cocaine
5	At 30 weeks' gestation, severe preeclampsia, symptoms of sleep-disordered breathing	42	White	Cesarean delivery (unscheduled for BP and liver enzymes)	Spinal; postoperative PCA	**Airway obstruction**; 9 h postoperative in hospital room, patient found to be pulseless and apneic	a) Failed resuscitation with difficult intubation during code attempt c) Morphine level 79 ng/ml
6	Term pregnancy, 39 years old, tobacco, untreated hypertension	50	Hispanic	Cesarean delivery (elective repeat)	Epidural; converted to GA with ETT; extubated before transfer to PACU	High spinal; CP arrest after epidural test dose	a) Second CP arrest, failed resuscitaiton b) Postoperative day 1 c) Acute MI, previous MI, CAD
7	Term pregnancy	42	Black	Cesarean delivery (elective repeat and breech)	Spinal; converted to GA with ETT; transferred to ICU intubated	Neuraxial cardiac arrest; bradycardia, then CP arrest 17 min after SAB placement	a) Unplanned extubation in the ICU b) 26 days postpartum c) Anoxic encephalopathy
8	At 15 weeks' gestation, fetal demise; maternal "heart enlargement," systolic murmur, lateral ST changes on electrocardiogram; induced delivery with retained placenta	WNL	Black	Dilation and curettage (emergent for hemorrhage)	GA; ETT	CP arrest; ST depression preceded pulseless arrest during emergence from GA	a) CP arrest, failed resuscitation b) Cardiomyopathy

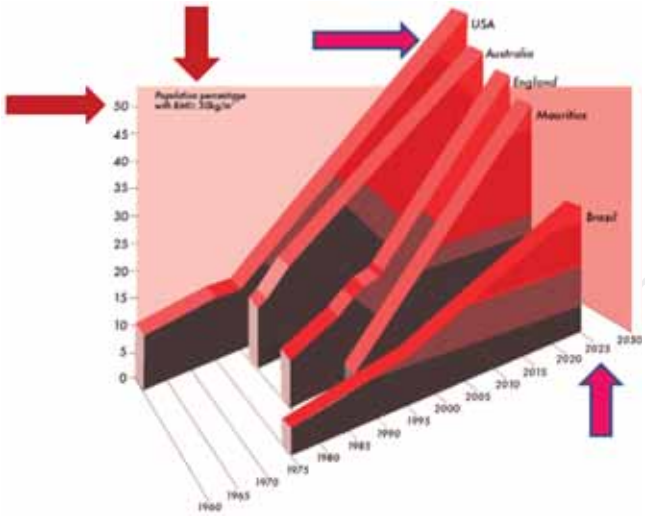
OBESITY: RACE AND ETHNICITY

- Incidence of obesity in the USA has doubled in adults and tripled in children
- Prevalence of obesity:
  - 60 million adults & 9 million children 6-19 years of age
  - Higher in women than men
  - African American had 51% higher prevalence of obesity
  - Hispanic population had 21% higher prevalence

- Prevalence of severe obesity (BMI > 30 m/kg) has the greatest growth this past decade
- Obesity is now the second leading cause of death
  - High incidence of co-morbidities



PROJECTED PREVALENCE OF OBESITY IN ADULTS BY 2025



PRE-EXTUBATION STRATEGY

Strategies and recommendation: extubation in operating room-airway exchange catheter (AEC)

- Maintaining a conduit within the trachea with AEC
- AEC allows the feasibility of resecuring the airway would add to patient safety
- Obstetric patients undergoing GA in whom AEC should be considered

  - Difficult airway/abnormal airway
  - Morbidly obese patients
  - Obstructive sleep apnea
  - African American women with severe preeclampsia with? edematous airways

Strategies and recommendation: extubation in operating room-airway exchange catheter (AEC)

- Considerations for re-intubation over the AEC

  - Hypoxemia – SpO_2 < 90% or severe hypoxemia SpO_2 < 70%
  - Shortness of breadth
  - Tachypnea
  - Increased work of breathing
  - Increased $ETCO_2$

- AEC - assisted reintubation: Recommendations

  - Cook –AEC 3.7 mm ED -11 F
  - Length of time to leave AEC: Varies from 30- 60 minutes up to 2 hours
  - Allows the feasibility of resecuring the airway would add to patient safety

Mort TC: Continuous airway access for the difficult extubation: The efficacy of the airway exchange catheter. Anesth Analg 2007;105(5):1357-62.

COMPLICATIONS OF THE REINTUBATION PROCEDURE

	AEC present (n = 51)	AEC absent (n = 36)	P value
First-pass success rate for reintubation	87%	14% (5)	< 0.02
Hypoxemia during reintubation (SpO_2 <90%)	8%b (4)	50% (18)	< 0.01
Severe hypoxemia during reintubation (SpO_2 < 70%)	6%a (3)	19% (7)	0.05
Bradycardia (heart rate < 40) with hypotension	4% (2)	14% (5)	< 0.05
Multiple intubation attempts (≥ 3) including the placement of an accessory airway device	10%[b] (5)	77% (28)	< 0.02
Esophageal intubation	0	18% (6)	
Rescue airway device/technique	6%[a] (3)	90% (32)	< 0.01

[A] Includes the AEC failures due to inability to pass ETT into trachea (1 case) and proximal migration of the AEC out of the trachea (3 cases)
AEC = airway exchange catheter, ETT = endotracheal tube

Mort TC. Continuous airway access for the difficult extubation: The efficacy of the airway exchange catheter. Anesth Analg 2007;105(5):1357-62.

POSTOPERATIVE STRATEGY

Strategies and recommendation: PACU staffing and equipment

- Establish protocols:
  - Adequate supervision of obstetric patients by appropriate anesthesia personnel similar to surgical patients
  - Adequately staffed recovery room capable of receiving and caring for all patients recovering from major RA or GA equal to that provided in the surgical suite
  - Availability of a properly equipped facility in the obstetric PACU
- Birthing facilities, when used for analgesia or anesthesia must be appropriate to provide safe anesthetic care during labor and delivery or post-anesthesia recovery care

POSTOPERATIVE MONITORING –$ETCO_2$

Strategies and recommendation: Postoperative monitoring –adequacy of ventilation

- Respiratory depression is the number one reason for codes in hospitals and the most common antecedent of in-hospital cardiac arrest: Fecho K: Opioids & Code Blue Emergencies Anesthesiology 2008;109:A34; Schein RM: Clinical antecedents to in-hospital cardiopulmonary arrest. Chest 1990;98:1388-1392
- A review of post-anesthesia oversedation claims, data from the ASA estimates that 62% of events could have been prevented with better monitoring: Metzner J, Posner KL, Domino KB: Current Opinion in Anesthesiology 2009M;22:502-508.
- The importance of monitoring of adequacy of ventilation is recognized by clinical studies and recommendations from a multitude of organizations which includes:
  - American Society of Anesthesiologists
  - JCAHO
  - Anesthesia patient safety foundation
  - Institute for safe medication practices

POSTOPERATIVE MONITORING STRATEGY–CAPNOGRAPHY

Strategies and recommendation: postoperative monitoring –respiratory monitoring

- Microstream® Capnography with Integrated Pulmonary Index provides a complete picture of the patient's respiratory status which includes:

  - Accurate physiologic respiratory rate
  - Adequacy of ventilation represented by a numeric value for end tidal CO_2
  - A breadth to breadth waveform that indicates any respiratory conditions such as hypoventilation, apnea, or airway obstruction

	RR	Tidal volume	Alveolar ventilation	$ETCO_2$
Patient 1	12 b/m	500 mL	4.2 l/m	37 mmHg
Patient 2	12 b/m	200 mL	0.6 l/m	70 mmHg

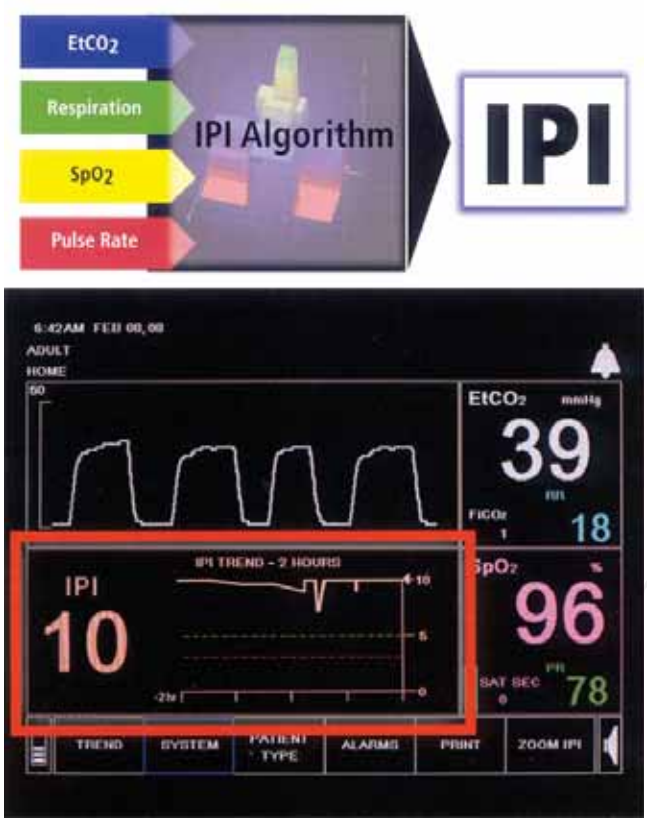
ADEQUACY OF RESPIRATORY MONITORING RECOMMENDATION: MAXIMIZING PATIENT SAFETY

Postoperative monitoring –capnography

IPI	Patient status
10	Normal
8-9	Within normal range
7	Close to normal range; requires attention
5-6	Requires attention and may require intervention
3-4	Requires intervention
1-2	Requires immediate intervention

- Smart capnography alarm respiratory analysis (SARA) and integrated pulmonary index (IPI) IPI with built in algorithms provides early indication of changes in patient's ventilatory status by utilizing
  - $ETCO_2$
  - Respiratory rate
  - Pulse rate
  - SpO

SARA CAPNOGRAPHY &
INTEGRATED PULMONARY INDEX



AVOIDING CATASTROPHES DURING INDUCTION/INTUBATION CONCLUSION

- Airway problems in obstetrics -the leading cause of maternal morbidity/mortality
  - **Difficult laryngoscopy/difficult intubation:**
    - Eschmann ETT introducer *vs* fiberoptic optical stylets are useful in Grade III (especially Grade III B) view
      - Other video-assisted laryngoscopes as an immediate step Glide scope, Storz, Airtraq, Pentax, McGrath
  - **Difficult ventilation:**
    - LMA (Classic, ILMA, ProSeal LMA) shown to be successful in obstetrics after failed intubation
  - **Failed intubation/difficult ventilation/prevention of aspiration:**
    - Non-invasive techniques: combitube, S -Laryngeal tube have proven to be successful in obstetrics after failed intubation
  - **Critical airway: (Increasing hypoxemia)**
    - Invasive Techniques – Cricothyroidotomy, Tracheostomy

AVOIDING CATASTROPHES FOLLOWING EXTUBATION & EMERGENCE CONCLUSION

- Pre-extubation
  - Patient safety strategy: Maintaining a conduit with an airway exchange catheter within the trachea
    - Allows feasibility of resecuring the airway in high risk patients
- Postoperative period
  - Patient safety strategy: Adequate supervision by appropriate anesthesia personnel and appropriate equipment is required to avert postoperative adverse airway-related catastrophes
- Implementation of monitoring
  - Patient safety strategy: Monitoring of not only oxygen saturation but also adequacy of ventilation with smart capnography in high risk obstetric patients – DA, Obese, OSA, Massive volume resuscitation, severe preeclampsia with edematous airways, significant co-morbidities

Annual Refresher Course of Anesthesiology and Perioperative Medicine Mexico City