Avoiding airway catastrophes in obstetrical patients

I have no financial disclosures or conflict of interest

Maya S Suresh, MD

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

<table>
<thead>
<tr>
<th>Year of death</th>
<th>Case fatality rates*</th>
<th>Rate ratios</th>
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<tbody>
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<td>General anesthetic</td>
<td>Regional anesthetic</td>
<td>Rate ratios</td>
</tr>
<tr>
<td>1979-1984</td>
<td>20.0</td>
<td>8.6</td>
</tr>
<tr>
<td>1985-1990</td>
<td>32.3</td>
<td>1.9</td>
</tr>
<tr>
<td>1991-1996</td>
<td>16.8</td>
<td>2.5</td>
</tr>
<tr>
<td>1997-2002</td>
<td>6.5</td>
<td>3.8</td>
</tr>
</tbody>
</table>

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


**Anesthesia - related mortality 1979-1990**
1979-1990
82% deaths during C/D

[Diagram showing distribution of anesthesia-related mortality]


**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**

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


**FAILED INTUBATION TIME AND URGENCY OF OPERATION**

<table>
<thead>
<tr>
<th>Time of operation</th>
<th>Cesarean sections</th>
<th>Failed intubations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day (08:00-17:00)</td>
<td>85%</td>
<td>22%</td>
</tr>
<tr>
<td>Evening (17:00-21:00)</td>
<td>4%</td>
<td>9%</td>
</tr>
<tr>
<td>Night (21:00-08:00)</td>
<td>12%</td>
<td>69%</td>
</tr>
<tr>
<td>Plus weekend Urgency of operation</td>
<td>56%</td>
<td>9%</td>
</tr>
<tr>
<td>Elective</td>
<td>44%</td>
<td>91%</td>
</tr>
</tbody>
</table>


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

<table>
<thead>
<tr>
<th>Mallampati class</th>
<th>IV</th>
<th>11.30</th>
<th>Receding mandible TMD &lt; 6 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>7.58</td>
<td>Protruding maxillary incisors</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>3.23</td>
<td>Short neck &lt; ROM neck</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>9.71</td>
<td>8.00</td>
<td>5.01</td>
</tr>
</tbody>
</table>

Avoiding airway catastrophes in obstetrical patients

PROBABILITY OF EXPERIENCING DIFFICULT INTUBATION FOR VARYING COMBINATIONS OF RISK FACTORS

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

HOW WOULD YOU PROCEED?

ASA DIFFICULT AIRWAY ALGORITHM

1. Assess the likelihood and clinical impact of basic management problems
   A. Difficult Ventilation
   B. Difficult Intubation
   C. Difficulty with Patient Cooperation or Consent
   D. Difficult Tracheostomy

2. Actively pursue opportunities to deliver supplemental oxygen throughout the process of difficult airway management

3. Consider the relative merits and feasibility of basic management choices:
   A. Awake Intubation vs. Intubation Attempts after Induction of General Anesthesia
   B. Non-Invasive Technique for Initial Approach to Intubation vs. Invasive Technique for Initial Approach to Intubation
   C. Preservation of Spontaneous Ventilation vs. Ablation of Spontaneous Ventilation

4. Develop primary and alternative strategies.

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

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**
  - Call for help
  - Call for difficult airway cart
  - Consider awakening the patient
  - Return to spontaneous ventilation
  - Verify intubation by capnography
  - Proceed with cesarean delivery

**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

  **Poor view**

  **Alternative devices**

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

  **Supraglottic airway**

  **Unsuccessful MV**

  **LMA™**
  - Confirm ventilation, oxygenation, anesthesia, CVS stability and muscle relaxation
  - Attempt tracheal intubation via LMA™ (blind or fiberoptic assisted)
  - Verify intubation by capnography
  - Proceed with cesarean delivery

**Step 4. «CICV» Scenario**
- Non-invasive Rescue ventilation
  - Combitube™
  - King LTS™/LTS-D™

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

**Step 5. «CICV» Scenario**
- Increasing hypoxemia
  - Critical airway
  - Hypoxemia
  - Invasive airway access

**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

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


BURP (BACKWARD, UPWARD, AND RIGHT) MANEUVER

Difficult laryngoscopy made easy with BURP Maneuver optimal external laryngeal manipulation


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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**Direct laryngoscopy**

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

**Unsuccessful**

**Verify intubation by capnography**
- Proceed with cesarean delivery

**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**

**Successful**

**Verify intubation by capnography**
- Proceed with cesarean delivery

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

**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**

**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**

**Non-invasive alternative devices**

**Combitube™**
- King LTS™/LTS-D™

**Successful**

**Verify intubation by capnography**
- Proceed with cesarean delivery

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

**Critical airway**

**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)
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- External laryngeal manipulation (BURP maneuver)
- **Direct laryngoscopy**
- **Successful tracheal intubation**
  - Verify intubation by capnography
  - Proceed with cesarean delivery
- **Difficult laryngoscopy**

**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**
  - **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**
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  - Proceed with cesarean delivery

**Step 3. Maintenance of oxygenation/ventilation**
- Face mask ventilation (MV)
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- Difficult Ventilation
- **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-emergency pathway**
- **Unsuccessful MV**
- **CICV**
  - **Non-invasive alternative devices**
  - **Combitube™**
  - **King LTS™/LTS-D™**
- **Successful tracheal intubation**
  - Confirm oxygenation, anesthesia, CVS stability
  - Proceed with cesarean delivery
- **Failed Ventilation**

**Step 5. «CICV» Scenario**
- **Increasing hypoxemia**
- **Critical airway**
- **CICV**
  - **Hypoxemia**
  - **Invasive airway access**
  - **Cricothyroidotomy**
  - Transtracheal jet ventilation
- **Successful ventilation**
  - Confirm oxygenation, anesthesia, CVS stability
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Failed intubation

Dif\textsuperscript{f}fi\textsuperscript{c}ult laryngoscopy

Direct laryngoscopy

Successful tracheal intubation

- Call for help
- Call for difficult airway cart
- Consider awakening the patient
- Return to spontaneous ventilation
- Verify intubation by capnography
- Proceed with cesarean delivery

**Step 2. Second tracheal intubation**
- Maintain 30N cricoid pressure
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- Assess laryngoscopic view
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Failed intubation

Dif\textsuperscript{f}fi\textsuperscript{c}ult intubation

Dif\textsuperscript{f}fi\textsuperscript{c}ult ventilation

- Reduce cricoid pressure
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- Avoid exteriorization of uterus
- Avoid fundal pressure during delivery
- Proceed with delivery of fetus

**Step 4. «CICV» Scenario**

Non-invasive Rescue ventilation

Failed ventilation

Successful tracheal intubation

- Combitube™
- King LTS™/LTS-D™
- Confirm oxygenation, anesthesia, CVS stability
- Proceed with cesarean delivery

**Step 5. «CICV» Scenario**

Increasing hypoxemia Invasive rescue ventilation

CICV Hypoxemia

Successful ventilation

- Cricothyroidotomy
- Transtracheal jet 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)
CLASSIFICATION OF CORMACK LEHANE GRADE III LARYNGOSCOPIC VIEW


EFFICACY OF FIBEROPTIC OPTICAL STYLET: FAILED FIRST ATTEMPT AT INTUBATION

• 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

Grade III A

Mean time to success, s

Grading classification

Laryngoscopy view

Grade III A

Mean time to success, s

Grading classification

- Fiberoptic optical stylet

Grade III B

Mean time to success, s

Grading classification

- Fiberoptic optical stylet

Grade III A

Mean time to success, s

Grading classification

- Fiberoptic optical stylet

Grade III B

Mean time to success, s

Grading classification

- Fiberoptic optical stylet

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


Suresh MS. Avoiding airway catastrophes in obstetrical patients

www.medigraphic.org.mx
UNANTICIPATED DIFFICULT TRACHEAL INTUBATION, DURING RAPID SEQUENCE INDUCTION OF ANESTHESIA, IN THE OBSTETRIC PATIENT

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**Difficult laryngoscopy**
- Direct laryngoscopy
- Failed intubation

**Step 2. Second tracheal intubation**
- Maintain 30N cricoideal 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

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

**Unsuccessful MV**
- Supraglottic airway

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

**CICV**
- Combitube™
- King LTS™/LTS-D™

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

**Invasive airway access**
- Cricothyroidotomy
- Transtracheal jet ventilation

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

- 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

<table>
<thead>
<tr>
<th></th>
<th>C+L 1</th>
<th>C+L 2</th>
<th>C+L 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard view</td>
<td>14 (52)</td>
<td>12 (44)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Videolaryngoscope view</td>
<td>27 (100)</td>
<td>0 (0)</td>
<td>9 (0)</td>
</tr>
</tbody>
</table>

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

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- Verify intubation by capnography
- Direct laryngoscopy
- Successful tracheal intubation
- 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 ventilation with face mask
- Assess laryngoscopic view
- External laryngeal manipulation (BURP maneuver)
- Verify intubation by capnography
- Alternative devices
- Reduce cricoid pressure
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- Non-emergency pathway
- Successful 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
- Combitube™
- King LTS™/LTS-D™
- Non-invasive alternative devices
- Invasive airway access
- Invasive ventilation
- Successful tracheal intubation
- Confirm oxygenation, anesthesia, CVS stability
- Proceed with cesarean delivery

Step 5. «CICV» Scenario
- Invasive rescue ventilation
- Cricothyrotomy
- Transtracheal jet ventilation
- Critical airway
- Successful ventilation
- Confirm oxygenation, anesthesia, CVS stability
- Proceed with cesarean delivery

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ADDITIONAL REPORTS: USE OF INTUBATING LMA IN OBSTETRICS

- ILMA /FASTRACH™ has been used in parturients after failed intubation
- 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

- Unanticipated DA—Several case reports—successful use of ETC (bull neck, lockjaw, difficult anatomy)
  - Eur Arch Otorhinol 1991;248:129-31
  - Anaes Intensiv Notfallmed Schmerz 1996;31:191-3
  - 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

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

- Another case of use of the ProSeal LMA in a difficult obstetric airway. Vaida SJ et al. BJA 2004;92:905.
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- Direct laryngoscopy
- Not more than 2 attempts at intubation
- Call for help
- Call for difficult airway cart
- Consider awakening the patient
- Return to spontaneous ventilation
- Verify intubation by capnography
- Proceed with cesarean delivery

**Step 2. Second tracheal intubation**
- Maintain 30N cricoid pressure
- Maintain oxygenation and ventilation with face mask
- Assess laryngoscopic view
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- Failed intubation
- Non emergent pathway
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- King LTS™/LTS-D™
- Cricothyroidotomy
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- Confirm oxygenation, anesthesia, CVS stability
- Proceed with cesarean delivery

**Step 3. Maintenance of oxygenation/ventilation**
- Face mask ventilation (MV)
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- Transtracheal jet ventilation
- Confirm oxygenation, anesthesia, CVS stability
- Proceed with cesarean delivery

**Step 4. «CICV» Scenario Non-invasive Rescue ventilation**
- Failed ventilation-Critical Airway
- Non-invasive alternative devices
- Combitube™
- King LTS™/LTS-D™
- Confirm oxygenation, anesthesia, CVS stability
- Proceed with cesarean delivery

**Step 5. «CICV» Scenario Increasing hypoxemia Invasive rescue ventilation**
- Hypoxemia
- Invasive airway access
- Cricothyroidotomy
- Transtracheal jet ventilation
- Confirm oxygenation, anesthesia, CVS stability
- Proceed with cesarean delivery

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- External laryngeal manipulation (BURP maneuver)
  - Failed intubation
  - Profile view
  - Alternative devices
  - Not more than 2 attempts at intubation
- Reducing 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
- 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

**Step 4. «CICV» Scenario**
- Non-invasive rescue ventilation
- Failed ventilation
- CICV
- 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
- 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)
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

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


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

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 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

Suresh MS. Avoiding airway catastrophes in obstetrical patients

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Pregnancy-Associated Deaths</th>
<th>Pregnancy-Related Deaths</th>
<th>Anesthesia-Related Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>65</td>
<td>55</td>
<td>15</td>
</tr>
<tr>
<td>1986</td>
<td>55</td>
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<td>2003</td>
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<td>0</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient</th>
<th>Maternal Condition</th>
<th>BMI, kg/m²</th>
<th>Race</th>
<th>Procedure (Surgery)</th>
<th>Anesthesia Type</th>
<th>Airway Management; Postoperative Care</th>
<th>Most Likely Complication of Anesthesia; Presentation</th>
<th>a) Immediate Cause of Death</th>
<th>b) Time of Death if Delayed</th>
<th>c) Autopsy Findings</th>
</tr>
</thead>
</table>
| 1       | Term pregnancy with
| RRHT, refused spinal
| anesthesia | 33     | Black | Cesarean delivery
| (emergent for
| RRHT)     | GA; ETT | Airway obstruction; CP
| arrest during emergence from
| GA         |                                           |                                             |                      | CP arrest, failed resuscitation        |
| 2       | 24-wk spontaneous
| vaginal stillbirth of
| twins, retained placenta | 37     | Black | Dilatation and
| curettage
| (emergent for hemorrhage) | GA; ETT intubated before transfer to
| PACU      |                                           |                                             |                      | CP arrest, failed resuscitation        |
| 3       | Undesired pregnancy
| in the 1st trimester | 39     | Black | Vacuum aspiration
| (elective) | Deep sedation; IV | Hypoventilation airway
| obstruction; 25 min
| after arrival in PACU, patient found
to be pulseless and apneic |                                           |                                             |                      | 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 |                                           |                                             |                      | CP arrest, failed resuscitation        |
| 5       | At 39 wks’ gestation,
| severe preeclampsia, symptoms of sleep-
| disorders, breathing | 42     | White | Cesarean delivery
| (elective repeat) | Spinal; postoperative PCA | Airway obstruction; 9 h
| postoperative in hospital room, patient
to be pulseless and apneic |                                           |                                             |                      | CP arrest, failed resuscitation        |
| 6       | Term pregnancy, 39
| years old, tobacco,
| withdrawn hypertension | 50     | Hispanic | Cesarean delivery
| (elective repeat) | Epidural; converted to
| GA with ETT, intubated before
| transfer to PACU | High spinal; CP arrest after
| epidural test dose |                                           |                                             |                      | Second CP arrest, failed resuscitation |
| 7       | Term pregnancy | 42     | Black | Cesarean delivery
| (elective, repeat
| and breech) | Spinal; converted to
| GA with ETT, transferred to ICU
| intubated | Neuropathic cardiac arrest;
| bradycardia, then CP arrest 17
| min after SAB placement |                                           |                                             |                      | Unplanned extubation in
| the ICU | 26 days postpartum | Anoxic encephalopathy |
| 8       | At 15 wks’ gestation,
| fetal demise: maternal
| “heart enlargement,” systolic
| murmur, lateral ST changes on
| electrocardiogram, induced delivery with
| retained placenta | WNL    | Black | Dilatation and
| curettage
| (emergent for hemorrhage) | GA; ETT | CP arrest; ST depression
| preceded pulseless arrest during emergence from GA |                                           |                                             |                      | CP arrest, failed resuscitation        |

www.medigraphic.org.mx
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

PRE-EVENT STRATEGIES

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

PROJECTED PREVALENCE OF OBESITY IN ADULTS BY 2025

- Hypoxemia – SpO\text{2} < 90% or severe hypoxemia SpO\text{2} < 70%
- Shortness of breadth
- Tachypnea
- Increased work of breathing
- Increased ETCO\text{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

COMPLICATIONS OF THE REINTUBATION PROCEDURE

<table>
<thead>
<tr>
<th></th>
<th>AEC present (n = 51)</th>
<th>AEC absent (n = 36)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>First-pass success rate</td>
<td>87%</td>
<td>14% (5)</td>
<td>&lt; 0.02</td>
</tr>
<tr>
<td>for reintubation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypoxemia during</td>
<td>8%b (4)</td>
<td>50% (18)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>reintubation (SpO₂ &lt; 90%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe hypoxemia during</td>
<td>6%a (3)</td>
<td>19% (7)</td>
<td>0.05</td>
</tr>
<tr>
<td>reintubation (SpO₂ &lt; 70%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bradycardia (heart rate</td>
<td>4% (2)</td>
<td>14% (5)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>&lt; 40) with hypotension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple intubation</td>
<td>10%b (5)</td>
<td>77% (28)</td>
<td>&lt; 0.02</td>
</tr>
<tr>
<td>attempts (≥ 3) including</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the placement of an</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>accessory airway device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Esophageal intubation</td>
<td>0</td>
<td>18% (6)</td>
<td></td>
</tr>
<tr>
<td>Rescue airway</td>
<td>6%a (3)</td>
<td>90% (32)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>device/technique</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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


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—ETCO₂

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 Emergen-

- 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

- 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 CO₂
  - A breadth to breadth waveform that indicates any respiratory conditions such as hypoventilation, apnea, or airway obstruction

<table>
<thead>
<tr>
<th>RR</th>
<th>Tidal volume</th>
<th>Alveolar ventilation</th>
<th>ETCO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>12 b/m</td>
<td>500 mL</td>
<td>4.2 l/min</td>
</tr>
<tr>
<td>Patient 2</td>
<td>12 b/m</td>
<td>200 mL</td>
<td>0.6 l/min</td>
</tr>
</tbody>
</table>
Adequacy of Respiratory Monitoring

**Recommendation: Maximizing Patient Safety**

Postoperative monitoring – capnography

<table>
<thead>
<tr>
<th>IPI</th>
<th>Patient status</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Normal</td>
</tr>
<tr>
<td>8-9</td>
<td>Within normal range</td>
</tr>
<tr>
<td>7</td>
<td>Close to normal range; requires attention</td>
</tr>
<tr>
<td>5-6</td>
<td>Requires attention and may require intervention</td>
</tr>
<tr>
<td>3-4</td>
<td>Requires intervention</td>
</tr>
<tr>
<td>1-2</td>
<td>Requires immediate intervention</td>
</tr>
</tbody>
</table>

- 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
  - ETCO₂
  - Respiratory rate
  - Pulse rate
  - SpO₂

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