GENERAL ANAESTHESIA FOR CAESAREAN SECTION:

Sydney, March 2014

Roshan Fernando, University College Hospitals, London, UK
maternal death

In the first woman, the anaesthetist failed to stop trying to intubate the trachea even though oxygenation was achieved through an intubating laryngeal mask airway (ILMA).

Failed intubation guidelines were followed, to an extent, in this very stressful situation, but oesophageal intubation through the ILMA was not recognised and further hypoxia occurred.

The woman was coughing but was not allowed to wake up, and a second dose of thiopental and a long-acting neuromuscular-blocking drug were given even though the end-expiratory CO2 monitor indicated that the woman’s lungs were not being ventilated.

Cricothyrotomy was not attempted.
MATERNAL DEATHS

- failed ventilation (ILMA)
- displaced tracheostomy (ICU)
- opioid overdose (iv PCA)
- incompatible blood
- iv syntometrine > cardiac arrest (drug abuser)
- aspiration (waking up from GA; full meal)
- leucoencephalitis (spinal empyema)

7 deaths

CMACE 2006-8
MATERNAL MORBIDITY

- failed tracheal intubation > awake fibreoptic >
  failed cricothyrotomy > ILMA successful

- failed intubation > failed LMA > aspiration
  gastric contents; eventually McCoy > intubation

- failed intubation > LMA rescue > MOH > ENT
  tracheostomy

- severe bronchospasm (?suxamethonium induced) -
  mimicking failed intubation; x3 grade 2
  intubation attempts!

NAP4 2008-9

4 cases
failed intubation

- mask ventilate
- intubation attempt
- mask ventilate
- supraglottic airway
- spontaneous ventilation

A&A 2011
SOUL SEARCHING ..... 

- was I prepared adequately?
- was pre-oxygenation optimised?
- was cricoid effective?
- should I have used thiopentone?
- suxamethonium OR rocuronium
- did I have an airway plan A or B or C or D?
- lack of support!
PREPARATION

- planning & preparation; “ward rounds”
- good communication between teams

- communication with obstetricians
- more epidurals for labour analgesia
- urgency of caesarean delivery
- communication with midwives
- troubleshooting epidurals
- anaesthetists - not just technicians
PREPARATION

- planning & preparation
- good communication between teams
- **GA training; failed intubation drills, simulation; support for trainees**
- equipment; airway trolleys
  - SAD
  - videolaryngoscopes
Plan A: Initial tracheal intubation plan
- Direct laryngoscopy
  - Succeed: Tracheal intubation
  - Failed intubation

Plan B: Secondary tracheal intubation plan
- ILMA™ or LMA™
  - Succeed: Confirm - then fibroptic tracheal intubation through ILMA™ or LMA™
  - Failed oxygenation

Plan C: Maintenance of oxygenation, ventilation, postponement of surgery and awakening
- Revert to face mask
  - Oxygenate & ventilate
  - Succeed: Postpone surgery
    - Awaken patient
  - Failed oxygenation

Plan D: Rescue techniques for "can't intubate, can't ventilate" situation
- LMA™
  - Improved oxygenation
    - Awaken patient
  - Increasing hypoxaemia
    - Cannula cricothyroidotomy
    - Surgical cricothyroidotomy
    - Fail

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DUBLINT AIRWAY SOCIETY
PREPARATION

- planning & preparation
- good communication between teams
- GA training; failed intubation drills, simulation
- equipment; airway trolleys
- SAD
- videolaryngoscopes
PRE-O2

- ↓ FRC; DAWD 7 min (non-preg) vs. 2 min (preg)
- 3 min TV breathing vs. 8 DBs (FGF = 10 L/min O2)
- ETO2 > 90%
- 30 degree head up position (↑FRC)
- ramped position (HELP)
- pregnant women → FRC / helium dilution
- supine vs. 30° head-up tilt vs. upright
- FRC 188 ml increase: supine vs. 30° headup
- ? 30 sec increase in desaturation time
- intubation & head-up position?

FRC in pregnancy

Hignett, Fernando A&A 2011
CRICOID PRESSURE
rapid sequence induction, 50 yrs ago ...

- no lateral table tilt
- no cricoid pressure
- bag & mask ventilation
CRICOID PRESSURE?

- compression of the post-cricoid hypopharynx during CP
- oesophagus originates below cricoid
- ? opening pressure of the upper oesophageal sphincter
- CP can cause airway problems!
MRI study

- cricoid → 35% reduction in AP diameter of hypopharynx
- cricoid & hypopharynx move together as single unit
- oesophageal position irrelevant to Sellick’s manoeuvre
- 20 volunteers / MRI ± cricoid pressure
- 4/20 → unchanged cricovertebral distance
- 10/16 incomplete oesophageal occlusion
- all incomplete occlusions had lateral oesophageal deviation

Boet, 2010
CRICOID FORCE - SAFETY?

- Airway distortion
- Difficult insertion supraglottic airway
- Unable to ventilate
- Difficult laryngoscopy
- Difficult intubation
- Laryngeal trauma
- Technique failure
- Oesophageal rupture
- Regurgitation
all induction agents are OK .....
remifentanil bolus > infusion

propofol TCI

intubation: suxamethonium only!

6 babies needed mask ventilation

van de velde, IJOA 2004
SUXAMETHONIUM FOR RSI

- limited time > failed intubation
- wait for fasiculations!
- relaxation not certain
- ↑ K+
- ↓ desaturation time vs. roc
- malignant hyperthermia
- dangerous recovery phase
- masseter spasm
**SUXAMETHONIUM & DESATURATION TIMES**

**propofol induction** + **lidocaine** + **fentanyl**

- Rocuronium 1mg/kg (R)
- Sux 1.5mg/kg (S)
- Sux only 1.5mg/kg (SO)
  - (no lidocaine + fentanyl)

**Rocuronium 400 sec to SpO2 <95%**

? due to muscle fasiculation > ↑ O2 consumption

Taha, Anaesthesia 2010
ROCURONIUM

- time to T1 - max depression
- roc 0.6mg/kg (licensed c section)
- < 60 sec, intubation time
- 60+ min, duration

Magorian, Anesthesiology 1993
OBSTETRIC CASE SERIES

Williamson & Barclay - Acta Anaes Scand 2011

- 18 c section patients

- rocuronium 1.2mg/kg

- intubation at 60 sec

- TOF monitoring

- sugammadex 4mg/kg

Rocuronium and sugammadex for rapid sequence induction of obstetric general anaesthesia

R. M. WILLIAMSON, S. MALLAKU and P. BARCLAY
Liverpool Women's Hospital, Liverpool, UK

Background: Many anaesthetists use rocuronium in place of succinylcholine for rapid sequence induction (RSI). This is less common in obstetric anaesthetics as the duration of action of an effective dose of rocuronium exceeds most obstetric procedures. Sugammadex offers the possibility of rapidly reversing profound neuromuscular blockade at the end of surgery. We aimed to determine whether rocuronium 1.2mg/kg used for RSI in the obstetric population would provide good intubating conditions at 60 s and would be effectively reversed by sugammadex at the end of surgery.

Methods: We present a prospective series of 18 patients who received rocuronium 1.2mg/kg at induction of anaesthesia, monitored with a train-of-four ratio (TOF)-Watch SX®, and reversed using sugammadex 4mg/kg.

Results: The mean (95% CI) onset time of rocuronium was 71 (55-86)s, and the mean 95% CI time to recovery of the TOF to ≥90% after the administration of sugammadex 4mg/kg at the end of surgery was 86 (69-104)s.

Conclusion: Rocuronium 1.2mg/kg reversed by sugammadex appears to be effective in the obstetric population.

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## Emergency Reversal

<table>
<thead>
<tr>
<th></th>
<th>Diaphragmatic Movement (s)</th>
<th>Reservoir Bag Movement (s)</th>
<th>Recordable ETCO2 (s)</th>
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</thead>
<tbody>
<tr>
<td>Rocuronium → Sugammadex 16mg/kg</td>
<td>220</td>
<td>217</td>
<td>228</td>
</tr>
<tr>
<td>Rocuronium → Sugammadex 10mg/kg</td>
<td>222</td>
<td>225</td>
<td>238</td>
</tr>
<tr>
<td>Suxamethonium → Saline</td>
<td>237</td>
<td>234</td>
<td>270</td>
</tr>
</tbody>
</table>

*Hogg, BJA 2010 (abstract)*

- Propofol / fentanyl
- Rocuronium 1mg/kg
- Suxamethonium 1mg/kg
- Sugammadex or saline @ 180 sec
VIDEOLARYNGOSCOPY
- improved views
- **channelled**
  - Airtraq, Pentax AS
- **non-channelled**
  - C-Mac, McGrath MAC
videolaryngoscopy

• routine intubation?

• difficult intubation?

• airway rescue device?

• ? glottic view = intubation

Glidescope

Pentax AWS (airway scope)

C - MAC

McGrath
supraglottic airways (SAD) - LMA

LMA Proseal

LMA supreme

LMA classic

LMA intubating
The laryngeal mask airway is effective (and probably safe) in selected healthy parturients for elective Cesarean section: a prospective study of 1067 cases

[Le masque laryngé est efficace et, probablement, sans risque pour une césarienne non urgente chez des parturientes en bonne santé : une étude prospective de 1 067 cas]

Han, CJA, 2001

The use of ProSeal laryngeal mask airway in caesarean section – experience in 3000 cases

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Department of Anesthesia, Farah Hospital, Amman, Jordan

Halaseh, Anaesth Int Care, 2010

- Seoul, Sth Korea
- elec CS
- classic LMA
- thio / sux / cricoid
- ventilated / volatile

- Amman, Jordon
- elec CS
- Proseal LMA
- propofol / roc / cricoid
- ventilated / volatile
The LMA Supreme™ in 700 parturients undergoing Cesarean delivery: an observational study

Utilisation du LMA Supreme™ chez 700 parturientes accouchant par césarienne: une étude observationnelle

Wei Yu Yao, MBBS · Shi Yang Li, MBBS · Ban Leong Sng, MBBS · Yvonne Lim, MBBS · Alex Tiong Heng Sia, MBBS

• Quanzhou, China
• Cat 3 or 4 c sections
• Supreme LMA
• propofol / roc / cricoid

CJA, 2012
low risk mother for elective c section under GA ....

- gastric emptying
- oesophageal barrier pressure
- propofol + rocuronium
- no cricoid
- Proseal LMA
- IPPV - sevoflurane
DIFFICULT AIRWAY
Management of the Anticipated Difficult Airway in the Pregnant Patient

**Planned Elective Caesarean section**
- RA
  - Spinal
    - CSE
    - Epidural
    - CSA
  - Have plan B if GA required
- Failed RA or RA contraindicated
  - GA
  - Awake intubation
  - Awake tracheostomy

**Planned Vaginal delivery**
- Early epidural, regular antacid prophylaxis, restrict oral intake
- Anaesthetic plan for emergency procedures
- NVD
- RA
  - Failed RA
  - Delivery
  - GA (See under planned elective GA)

**Anaesthetic antenatal referral**
MDT decision on mode of delivery
Discussion with patient
Airway management strategy (Plan A & B)
Documentation
Communication

**Abbreviations**
- MDT - Multidisciplinary team
- GA - General anaesthetic
- NVD - Normal vaginal delivery
- CSE - Combined spinal epidural
- CSA - Continuous spinal anaesthetic
- RA - Regional anaesthetic
Failed Intubation Algorithm in Obstetrics

**Plan A**
- Attempt to Improve View and Facilitate Intubation
  - Adjusting head and neck position, use a bougie or different laryngoscope, adjust cricoid pressure and laryngeal position
  - Failure to intubate
  - Failed Intubation Declared (Maximum two attempts)

**Plan C**
- Ventilate with face mask
  - Failure to ventilate
  - Ventilate with mask & Oral Airway
    - Failure to ventilate
    - Two person mask ventilation
      - Failure to ventilate
      - Supraglottic Airway
        - Failure to ventilate
        - Release cricoid pressure
          - Failure to ventilate

**Plan D**
- Narrow or large bore cannula cricothyroidotomy OR Surgical cricothyroidotomy
  - Combined Obstetric and Anaesthetic Decision
    - Unable to ventilate

**Grade 3 or 4 View at Laryngoscopy**
- Call for help
Plan C

Ventilate with face mask

Failure to ventilate

Ventilate with mask & Oral Airway

Failure to ventilate

Two person mask ventilation

Failure to ventilate

Supraglottic Airway

Failure to ventilate

Release cricoid pressure

Failure to ventilate

Cannot Intubate, Cannot Ventilate Scenario

Able to ventilate
DAS Extubation Guidelines: ‘At risk’ algorithm

**Step 1**
Plan extubation

- Assess airway and general risk factors

**Step 2**
Prepare for extubation

- Optimise patient factors
  - Cardiovascular
  - Respiratory
  - Metabolic / temperature
  - Neuromuscular

- Optimise other factors
  - Location
  - Skilled help / assistance
  - Monitoring
  - Equipment

**Key question:** is it safe to remove the tube?

**Step 3**
Perform extubation

- Yes
  - Awake extubation

- No
  - Advanced Techniques*
    1. Laryngeal mask exchange
    2. Remifentanil technique
    3. Airway Exchange Catheter
  - Postpone extubation
  - Tracheostomy

**Step 4**
Postextubation care

- Recovery / HDU / ICU

- Safe transfer
- Analgesia
- Handover / communication
- Staffing
- \(O_2\) and airway management
- Equipment
- Observation and monitoring
- Documentation
- General medical and surgical management

*Advanced techniques: require training and experience

Difficult Airway Society Extubation Algorithm 2011
AND ……………
BIS & AWARENESS

- Australasian survey, 1000 patients (2005-7)
- BIS or Entropy used in 32%
- 2 cases of awareness (1 in 382)
  - medication error “thiopentone” (water)
  - remi + isoflurane (0.2%) maintenance

Paech, IJOA 2008
‘Blood pressure was 200/105 mm/Hg in the anaesthetic room prior to (standard) induction of anaesthesia. Intubation proved difficult and systolic pressure was 195-210 mmHg for the first 15 minutes of the operation. Baby was delivered in reasonable condition but the mother could not be roused from general anaesthesia. A delayed CT scan showed massive intracranial haemorrhage. Hepatic haemorrhage was also seen at autopsy.’
Differential impacts of modes of anaesthesia on the risk of stroke among preeclamptic women who undergo Caesarean delivery: a population-based study

C.-J. Huang¹,²,³, Y.-C. Fan¹ and P.-S. Tsai⁴,⁵,⁶*

- Taiwan National Health Insurance research database
- 23 million Taiwanese population
- 303,862 c sections
- 378 stroke events
- stroke risk after GA for c section
  ONLY if pre-eclampsia

Huang, BJA 2010
GA & PREECLAMPSIA

BUT......

- absolute CVA numbers small
- no data on smoking, alcohol, SE status
- ? CVAs in non-hosp admissions
- GAs in sicker mums
- ↓ thromboembolic risk with regional blk

Huang, BJA 2010

stroke free survival
CONCLUSION

- my story ......
- plan for the “unexpected”
- communication
- preparation
- training / drills / simulation
- luck!