The Use of Laryngeal Mask Airway in Neonatal Ventilation

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COI statement

- Daniele Trevisanuto: No Conflict of Interest

Only two photographs remain out of those taken to record this experiment at “The London Hospital”

Medical Photography Department, Feb 1983

Evolution of the LMA concept

Neonatal LMA [size 1]
ADVANTAGES

- Avoid the leak around the mask
- Bypass the airway block

DISADVANTAGES

- Leak pressure at 22-25 cm H₂O
- Higher invasivity ???

(Berry AM, Emerg Med 1998; Tanaka, Anesthesiology 2003; Trevisanuto ADCF&N Ed)
Potential Applications of LMA in Neonates

1. Congenital airway malformations
2. Neonatal anesthesia
3. Neonatal transport
4. Neonatal resuscitation
5. Surfactant administration

Trevisanuto et al. Arch Dis Child Fetal Neonatal Ed 2004

Potential Applications of LMA in Neonates

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Trevisanuto et al. Arch Dis Child Fetal Neonatal Ed 2004

Congenital Upper Airway Malformations

- Congenital multiple arthrogryposis
- Anomalies of the cervical column
- Cri du Chat syndrome
- Down syndrome
- Edward syndrome
- Freeman-Sheldon syndrome
- Goldenhar syndrome
- Hurler syndrome
- Neck contracture
- Hydrocephalus
- Pierre Robin syndrome
- Schwartz-Jampel syndrome
- Tracheal Collins syndrome
- Kenny-Caffey syndrome

Pierre Robin Syndrome

Trevisanuto et al. Arch Dis Child Fetal Neonatal Ed 2004
Blind intubation via the laryngeal mask: a word of caution

The epiglottics may partially obstruct the distal aperture of the LMA in 25-50% of infants, but this is rarely apparent clinically.

S M Auden, Pediatric Anaesthesia 2000

Potential Applications of LMA in Neonates

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Trevisanuto et al. Arch Dis Child Fetal Neonatal Ed 2004
### Neonatal Transport

<table>
<thead>
<tr>
<th>Case</th>
<th>B.W. (Kg)</th>
<th>Postnatal age at LMA insertion</th>
<th>LMA insertion in relation to the transport time</th>
<th>Length of LMA placement</th>
<th>Upper airway malformations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.25</td>
<td>6 h</td>
<td>During</td>
<td>10 min</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>2.9*</td>
<td>24 h</td>
<td>Before and during</td>
<td>NA</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>2.8*</td>
<td>18 h</td>
<td>Before and during</td>
<td>NA</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>2.81*</td>
<td>32 min</td>
<td>Before</td>
<td>90 min</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>2.37*</td>
<td>5 min</td>
<td>Before and during</td>
<td>5 h</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* polyhydramnios

Trevisanuto D et al, Pediatrics 2005

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#### Laryngeal mask: beyond neonatal upper airway malformations

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>MV failure after programmed postoperative extubation</td>
<td>Aids ventilation and mechanical ventilation</td>
</tr>
<tr>
<td>Case 2</td>
<td>Accidental extubation during ambulance transport</td>
<td>Ease of positioning and reduced resistance compared to ETT in a difficult setting for airway management</td>
</tr>
<tr>
<td>Case 3</td>
<td>FN/EHTI failure in severe upper airway bleeding</td>
<td>Effective PPV in a severe &quot;can't ventilate/can't intubate&quot; situation</td>
</tr>
</tbody>
</table>

ETT, endotracheal intubation; MV, face mask failure; PPV, positive-pressure ventilation.


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### Potential Applications of LMA in Neonates

1. Congenital airway malformations
2. Neonatal anesthesia
3. Neonatal transport
4. **Neonatal resuscitation**
5. Surfactant administration

Trevisanuto et al. Arch Dis Child Fetal Neonatal Ed 2004

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### Figure 1
Laryngeal mask airway placement in case 2.

Effective positive pressure ventilation (PPV) is the most important intervention during neonatal resuscitation.

**Study Design**

1 min  |  2 min  |  1 min  
Training 1* (verbal and practical demonstration based on 6 key points)
Training 2* (repetition of verbal and practical demonstration based on 6 key points)
Training 3* (ventilatory trial and participant able to view data monitor)


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**Effect of a 2-minute training on the quality of face-mask ventilation in a low-resource setting**

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**Breaths with relevant mask leak (>25%)**

- Before the training: 89.7% (SD 21.5%)
- After the training: 45.4% (SD 27.2%)
- After the recall training: 18.3% (SD 20.1%)

**Breaths with a high PIP (>35 cm H$_2$O)**

- Before the training: 19.5% (SD 32.8%)
- After the training: 39.2% (SD 37.7%)
- After the recall training: 6.0% (SD 15.4%)

**Breaths within recommended PIP (20-35 cm H$_2$O)**

- Before the training: 7.1% (SD 12.3%)
- After the training: 41.0% (SD 33.7%)
- After the recall training: 61.1% (SD 29.3%)

This increment was enhanced if the participant had already attended a previous neonatal course (p=0.04).
Teaching effective FMV in a manikin can be easy and fast.
Teaching effective FMV in clinical practice is difficult.
Experience of caregivers strongly influences the quality of FMV.
About 15-20% of late-preterm and term infants fail FMV and need ...

Positive Pressure Ventilation (interfaces)
- Face mask
- Tracheal tube
- Laryngeal mask

Message n. 1 (FMV)

Effective PPV (RCT)
- (Zhu, Resuscitation 2011)
  - FMV: 84%
- (Trevisanuto, J Pediatr 2015)
  - FMV: 79%
5 to 10% require some degree of active resuscitation at birth (for example, stimulation to breathe)
3-5% require PPV
1% require ETT

Total newly born population

<table>
<thead>
<tr>
<th>Study</th>
<th>“Acceptable failure rate at first attempt”</th>
<th>Attempts (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mulcaster</td>
<td>10%</td>
<td>47</td>
</tr>
<tr>
<td>(Anaestesiology 2003)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Konrad</td>
<td>10%</td>
<td>57</td>
</tr>
<tr>
<td>(Anesth Analg 1998)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Learning curve for intubation
Appropriate level of proficiency

Cumulative Success Rate - All Providers

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubations (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Attempt (10)</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
</tr>
<tr>
<td>2nd Attempt (10)</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
</tr>
<tr>
<td>3rd Attempt (10)</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
</tr>
<tr>
<td>4th Attempt (10)</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
</tr>
<tr>
<td>5th Attempt (10)</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
</tr>
<tr>
<td>6th Attempt (10)</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
<td>15.0%</td>
</tr>
</tbody>
</table>

* Numbers of attempts

Dogliotti N et al. JMFNM 2011
Teaching effective ETT in clinical practice is very difficult.
Experience of caregivers strongly influences the success of ETT.
Exposure to procedure is becoming rare for pediatric residents.

Laryngeal Mask Airway: when?

Laryngeal Mask may be an effective alternative for establishing an airway during resuscitation of the newly born infant, in case of failure of facial mask ventilation and/or tracheal intubation... (Class Indeterminate). AHA, AAP, Pediatrics 2000.
Laryngeal Mask Airway: when?

2000 International Guidelines for Neonatal Resuscitation

Neonatal resuscitation

220 enrolled neonates

D Trevisanuto, Arch Dis Child Fetal Neonatal Ed 2004

Neonatal resuscitation

<table>
<thead>
<tr>
<th>Study</th>
<th>Effectiveness (%)</th>
<th>Adequate oxygenation</th>
<th>Circuit pressure, Audible leak</th>
<th>Circuit pressure, peak obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>95</td>
<td>&lt; 30 sec.</td>
<td>22 cmH2O</td>
<td>37 cmH2O</td>
</tr>
<tr>
<td>2</td>
<td>99</td>
<td>19 sec.</td>
<td>22 cmH2O</td>
<td>ND</td>
</tr>
<tr>
<td>3</td>
<td>99</td>
<td>&lt; 30 sec.</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

D Trevisanuto, Arch Dis Child Fetal Neonatal Ed 2004

2005 International Guidelines for Neonatal Resuscitation

Laryngeal mask airways (LMAs) that fit over the laryngeal inlet have been shown to be effective for ventilating newly born near-term and full-term infants (LOE 2\textsuperscript{m} and LOE 5\textsuperscript{t}).

AHA, AAP, Pediatrics 2006

Laryngeal Mask Airway: when?


The laryngeal mask airway may be considered as an alternative to a face mask for positive-pressure ventilation among newborns weighing >2000 g or delivered at ≥34 weeks’ gestation.

Perlman JM et al. Pediatrics, 2010