Supraglottic devices

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INTRODUCTION

• Supraglottic airway devices (SAD or SGD):

  • Inserted into the pharynx,
  • Ventilation,
  • Oxygenation,
  • Administration of anesthetic gases,
  • Without the need for endotracheal intubation
INTRODUCTION

• For anesthesia:
  • Primary airway management,
  • For rescue ventilation when facemask ventilation is difficult,
  • As a conduit for endotracheal intubation.
First generation SGA

- LMA Classic
- LMA Flexible
- LM Solus
- LM Portex Soft Seal
- LM AuraOnce
- Cobra PLA
- LMA Fastrach
- LM Aura-i
- Air-Q intubating laryngeal airway

CobraPLA: Cobra perilyngeal airway.
Second generation SGA

ProSeal LMA

Supreme LMA

Laryngeal Tube Suction-D

i-gel

AuraGain LM

Baska mask
Second-generation supraglottic airways.

Second-generation devices include:
- Different material from the original LMA.
- Bite blocks.
- Preformed shaft.
- Cuffs designed to improve the seal.
- Esophageal vents that allow orogastric tube placement.
- Blocker for the oesophagus.
Second-generation supraglottic airways.

- Flexible,
- Wire-reinforced,
- Smaller diameter than other
- Positioned away from the surgical field
- Useful for otolaryngologic, dental, and other head and neck procedures.
Second-generation supraglottic airways.

- In-built cuff pressure monitoring.

- Tru-Cuff LM inflation syringe:
  - Green zone on the syringe (40 to 60 mmHg)

- Self-inflating/pressurizing, low-pressure cuff:
  - Inflates during positive pressure ventilation.
  - Deflates to some extent during exhalation.
Insertion

Hold the LMA with the index finger at the junction of the cuff and the tube

Keep the neck flexed and head extended. Directing the tip against the hard palate
Insertion

Push the LMA backwards and downwards against the palate.

Press down on the LMA tube with the non-dominant hand while the finger is removed.
i-Gel

Gel cuff: not inflatable. Excellent seal. Eliminates concerns about cuff pressures.

Gastric vent. Integral bite block. Flange designed to prevent epiglottic folding.
i-Gel

Soft elastomer seals the device to the glottic structures
Comparison of Five 2nd-Generation Supraglottic Airway Devices for Airway Management Performed by Novice Military Operators

ProSeal LMA

Supreme LMA

Laryngeal Tube Suction-D

i-gel

SLIPA
Comparison of Five 2nd-Generation Supraglottic Airway Devices for Airway Management Performed by Novice Military Operators

Combat lifesavers, military paramedics, nurses, surgical scrub nurses, or junior doctors at the beginning of their training.
Comparison of Five 2nd-Generation Supraglottic Airway Devices for Airway Management Performed by Novice Military Operators

Combat lifesavers, military paramedics, nurses, surgical scrub nurses, or junior doctors at the beginning of their training.

Majority of training is performed on manikins or simulators.

ProSeal LMA
Supreme LMA
Laryngeal Tube
Suction-D
i-gel
SLIPA
Comparison of Five 2nd-Generation Supraglottic Airway Devices for Airway Management Performed by Novice Military Operators

<table>
<thead>
<tr>
<th>Device</th>
<th>Sealing site</th>
<th>Sealing mechanism</th>
<th>Aspiration protection</th>
<th>Disposable version</th>
<th>Conduit for intubation</th>
<th>Pediatric sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProSeal LMA</td>
<td>Perilaryngeal</td>
<td>Inflatable cuff</td>
<td>H-obstruction, drainage</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Supreme LMA</td>
<td>Perilaryngeal</td>
<td>Inflatable cuff</td>
<td>H-obstruction, drainage</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>i-gel</td>
<td>Perilaryngeal</td>
<td>Wedged sealing</td>
<td>H-obstruction, drainage</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SLIPA</td>
<td>Base of tongue</td>
<td>Wedged sealing</td>
<td>Storage, H-obstruction</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>LTS-D</td>
<td>Base of tongue</td>
<td>Inflatable cuff</td>
<td>D-obstruction, drainage</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

H-obstruction: high esophageal obstruction, D-obstruction: deep esophageal obstruction.
Comparison of Five 2nd-Generation Supraglottic Airway Devices for Airway Management Performed by Novice Military Operators

1-Evaluate the first-attempt insertion success rates of the devices and compare these between the groups.

2-Time needed for successful insertion, number of insertion attempts, oropharyngeal seal pressure (OSP), ease of insertion, fibre optic check of the vocal cords through the devices, and presence of perioperative oropharyngeal trauma or gastric content aspiration/regurgitation.
Comparison of Five 2nd-Generation Supraglottic Airway Devices for Airway Management Performed by Novice Military Operators

<table>
<thead>
<tr>
<th>Device</th>
<th>Successful</th>
<th>Unsuccessful</th>
<th>Total</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLMA</td>
<td>85</td>
<td>16</td>
<td>101</td>
<td>84.2</td>
</tr>
<tr>
<td>SLMA</td>
<td>97</td>
<td>5</td>
<td>102</td>
<td>95.1</td>
</tr>
<tr>
<td>i-gel</td>
<td>87</td>
<td>13</td>
<td>100</td>
<td>87.0</td>
</tr>
<tr>
<td>SLIPA</td>
<td>66</td>
<td>34</td>
<td>100</td>
<td>66.0</td>
</tr>
<tr>
<td>LTS-D</td>
<td>79</td>
<td>23</td>
<td>102</td>
<td>77.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>PLMA versus SLMA</th>
<th>PLMA versus i-gel</th>
<th>PLMA versus SLIPA</th>
<th>PLMA versus LTS-D</th>
<th>SLMA versus i-gel</th>
<th>SLMA versus SLIPA</th>
<th>SLMA versus LTS-D</th>
<th>i-gel versus SLIPA</th>
<th>i-gel versus LTS-D</th>
<th>SLIPA versus LTS-D</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>p</em></td>
<td>0.012*</td>
<td>0.689</td>
<td>0.003*</td>
<td>0.285</td>
<td>0.081</td>
<td>0.0001*</td>
<td>0.0004*</td>
<td>0.0007*</td>
<td>0.098</td>
<td>0.086</td>
</tr>
</tbody>
</table>
Comparison of Five 2nd-Generation Supraglottic Airway Devices for Airway Management Performed by Novice Military Operators

<table>
<thead>
<tr>
<th>Device</th>
<th>Insertion time (s, ±SD)</th>
<th>Oropharyngeal seal pressure (cm H₂O, ±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLMA</td>
<td>109.6 (61.5)</td>
<td>29.2 (6.8)</td>
</tr>
<tr>
<td>SLMA</td>
<td>70.4 (32.5)</td>
<td>24.8 (6.1)</td>
</tr>
<tr>
<td>i-gel</td>
<td>74.4 (41.1)</td>
<td>25.3 (6.9)</td>
</tr>
<tr>
<td>SLIPA</td>
<td>98.5 (59)</td>
<td>23.7 (6.1)</td>
</tr>
<tr>
<td>LTS-D</td>
<td>107.3 (67.9)</td>
<td>29.5 (8.9)</td>
</tr>
</tbody>
</table>
Comparison of Five 2nd-Generation Supraglottic Airway Devices for Airway Management Performed by Novice Military Operators

Coverage of the glottic opening (fibre optic assessment)

<table>
<thead>
<tr>
<th>Device</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLMA</td>
<td>60 (64.5%)</td>
<td>14 (15.1%)</td>
<td>16 (17.2%)</td>
<td>3 (3.2%)</td>
</tr>
<tr>
<td>SLMA</td>
<td>53 (54.1%)</td>
<td>19 (19.4%)</td>
<td>22 (22.4%)</td>
<td>4 (4.1%)</td>
</tr>
<tr>
<td>i-gel</td>
<td>70 (72.2%)</td>
<td>16 (16.5%)</td>
<td>10 (10.3%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>SLIPA</td>
<td>48 (58.5%)</td>
<td>9 (11%)</td>
<td>20 (24.4%)</td>
<td>5 (6.1%)</td>
</tr>
<tr>
<td>LTS-D</td>
<td>39 (41.1%)</td>
<td>20 (21.1%)</td>
<td>13 (13.7%)</td>
<td>23 (24.2%)</td>
</tr>
</tbody>
</table>
Comparison of Five 2nd-Generation Supraglottic Airway Devices for Airway Management Performed by Novice Military Operators

<table>
<thead>
<tr>
<th>Device</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLMA</td>
<td>34.3%</td>
<td>44.4%</td>
<td>15.2%</td>
<td>5.1%</td>
<td>1%</td>
</tr>
<tr>
<td>SLMA</td>
<td>61.4%</td>
<td>30.7%</td>
<td>7.9%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>i-gel</td>
<td>37.4%</td>
<td>48.5%</td>
<td>6.1%</td>
<td>6.1%</td>
<td>2%</td>
</tr>
<tr>
<td>SLIPA</td>
<td>7.1%</td>
<td>38.8%</td>
<td>24.5%</td>
<td>17.3%</td>
<td>12.2%</td>
</tr>
<tr>
<td>LTS-D</td>
<td>16.3%</td>
<td>43.9%</td>
<td>23.5%</td>
<td>13.3%</td>
<td>3.1%</td>
</tr>
</tbody>
</table>

1: very easy, 2: easy, 3: neither easy nor difficult, 4: difficult, and 5: very difficult
Difficult supraglottic airway device use

- Small mouth opening (<3 finger breadths)
- Neck radiation
- Tonsillar hypertrophy
- Fixed cervical spine flexion deformity
- Applied cricoid pressure
- Obesity
- Poor dentition or large incisors
- Male gender
Clinically important features of SGA use

- Easily placed blindly
- Less hemodynamic response to placement than laryngoscopy and ETT placement
- Lower risk of bronchospasm
- Lower peak inspiratory pressures possible
- Does not protect against aspiration
- Does not protect against laryngospasm
Intubation through a supraglottic airway device
Intubation through a supraglottic airway device:
Fiberoptic bronchoscope to guide intubation through a SAD
MRI: placement of LMA

1, proximal cuff; 2, epiglottis; 3, dorsal plate of the cricoid cartilage; G, glottis level

Area of the hypopharyngeal leak pressure (second seal).

Area of the oropharyngeal leak pressure
MRI: placement of LMA

1, proximal cuff; 2, epiglottis; 3, dorsal plate of the cricoid cartilage; G, glottis level

Area of the hypopharyngeal leak pressure (second seal).

Area of the oropharyngeal leak pressure.
Misplacement of SAD

Advanced inside the glottic area
Malposition of SAD

Advanced inside the glottic area

Ventilation is often possible with increased airway pressure and airway morbidity might be increased.
Incidence of this malposition: 6%.

Curr Opin Anesthesiol 2015, 28:717–726
Malposition of SAD

SGA tip stays above the postcricoid region

The tip lies too far cranially and does not reach the postcricoid region.
Malposition of SAD

SGA tip stays above the postcricoid region

The tip lies too far cranially and does not reach the postcricoid region.
Ventilation is usually possible without any problems.
Malposition of SAD

Downfolding of the tip.

Ventilation is usually possible

Curr Opin Anesthesiol 2015, 28:717–726
## Placement test

<table>
<thead>
<tr>
<th>Test</th>
<th>Question</th>
<th>Procedure</th>
<th>Expected results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placement</td>
<td>Gastric tube (‘bubble’) test</td>
<td>Drainage tube is sealed with a drop of gel followed by PPV</td>
<td>No gel or ‘bubbles’ upcoming the gastric channel</td>
</tr>
<tr>
<td>Suprasternal notch test</td>
<td>Is the tip of the SGA deep enough in the postcricoid region?</td>
<td>Drainage tube is sealed with a drop of gel and a slight pressure is applied to the suprasternal notch with a finger</td>
<td>Gel moves synchronously with the applied pressure</td>
</tr>
<tr>
<td>Insertion of a gastric tube</td>
<td>Downfolding of the tip?</td>
<td>Insertion of a gastric tube in the stomach via the drainage tube</td>
<td>Insertion without encountering any resistance</td>
</tr>
</tbody>
</table>
Air-Q intubating laryngeal airway
Fastrach™ or intubating LMA
i-Gel intubation
Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults

- **Plan A:** Facemask ventilation and tracheal intubation
  - Laryngoscopy
    - Failed intubation
      - Supraglottic Airway Device
        - Failed SAD ventilation
          - Final attempt at facemask ventilation
            - CICO
              - Cricothyroidotomy
              - Wake the patient up
            - Succeed: Wake the patient up
          - STOP AND THINK
            - Options (consider risks and benefits):
              1. Wake the patient up
              2. Intubate trachea via the SAD
              3. Proceed without intubating the trachea
              4. Tracheostomy or cricothyroidotomy
        - Succeed: Tracheal intubation
Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults

**Plan A:** Facemask ventilation and tracheal intubation

- Laryngoscopy
  - Succeed: Tracheal intubation
  - Failed intubation: Supraglottic Airway Device

**Plan B:** Maintaining oxygenation: SAD insertion

- Supraglottic Airway Device
  - Succeed: Options (consider risks and benefits):
    1. Wake the patient up
    2. Intubate trachea via the SAD
    3. Proceed without intubating the trachea
    4. Tracheostomy or cricothyroidotomy
  - Failed SAD ventilation: Final attempt at face mask ventilation

**Plan C:** Facemask ventilation

- Final attempt at face mask ventilation
  - Succeed: Wake the patient up
  - CICO: Cricothyroidotomy

**Plan D:** Emergency front of neck access
Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults

Plan A: Facemask ventilation and tracheal intubation
- Optimise head and neck position
- Preoxygenate
- Adequate neuromuscular blockade
- Direct / Video Laryngoscopy (maximum 3+1 attempts)
- External laryngeal manipulation
- Bougie
- Remove cricoid pressure
- Maintain oxygenation and anaesthesia

If in difficulty → call for help

Succeed
- Confirm tracheal intubation with capnography

Plan B: Maintaining oxygenation: SAD insertion
- 2nd generation device recommended
- Change device or size (maximum 3 attempts)
- Oxygenate and ventilate

Succeed
- STOP AND THINK
  - Options (consider risks and benefits):
  1. Wake the patient up
  2. Intubate trachea via the SAD
  3. Proceed without intubating the trachea
  4. Tracheostomy or cricothyroidotomy

Declare failed SAD ventilation

Plan C: Facemask ventilation
- If facemask ventilation impossible, paralyse
- Final attempt at facemask ventilation
- Use 2 person technique and adjuncts

Succeed
- Wake the patient up

Declare CICO

Plan D: Emergency front of neck access
- Scalpel cricothyroidotomy

Post-operative care and follow up
- Formulate immediate airway management plan
- Monitor for complications
- Complete airway alert form
- Explain to the patient in person and in writing
- Send written report to GP and local database

Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults

Management of unanticipated difficult tracheal intubation in adults

**Plan A: Facemask ventilation and tracheal intubation**
- Optimise head and neck position
- Preoxygenate
- Adequate neuromuscular blockade
- Direct / Video Laryngoscopy (maximum 3+1 attempts)
- External laryngeal manipulation
- Bougie
- Remove cricoid pressure
- Maintain oxygenation and anaesthesia

If in difficulty → call for help

**Plan B: Maintaining oxygenation: SAD insertion**
- 2nd generation device recommended
- Change device or size (maximum 3 attempts)
- Oxygenate and ventilate

**Plan C: Facemask ventilation**
- If facemask ventilation impossible, paralyse
- Final attempt at facemask ventilation
- Use 2 person technique and adjuncts

**Plan D: Emergency front of neck access**
- Scalpel cricothyroidotomy

**STOP AND THINK**
Options (consider risks and benefits):
1. Wake the patient up
2. Intubate trachea via the SAD
3. Proceed without intubating the trachea
4. Tracheostomy or cricothyroidotomy

**Post-operative care and follow up**
- Formulate immediate airway management plan
- Monitor for complications
- Complete airway alert form
- Explain to the patient in person and in writing
- Send written report to GP and local database

Confirm tracheal intubation with capnography

Wake the patient up
SAD and ventilation mode

PPV

Spontaneous breath
SAD and ventilation mode

Pressure-limited ventilation

PPV

Spontaneous breath
Pressure-controlled ventilation

- PCV is a mode commonly used with SGAs.

- PCV # VCV:
  - respiratory rate and peak inspiratory: set to avoid high peak pressures
  - To prevent airway gas leaks and gastric insufflation.

- Peak pressure set between 15 and 20 cmH$_2$O.
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<td>SLIPA</td>
<td>98.5 (59)</td>
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<td>LTS-D</td>
<td>107.3 (67.9)</td>
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</tbody>
</table>
Randomized prospective trial comparing two supraglottic airway devices: i-gel and LMA-Supreme in paralyzed patients

<table>
<thead>
<tr>
<th></th>
<th>i-gel™ (n = 50)</th>
<th>LMA-Supreme™ (n = 50)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attempts (1 / 2 / crossover / intubation)</td>
<td>43 / 3 / 2 / 2</td>
<td>44 / 2 / 3 / 1</td>
<td>0.77</td>
</tr>
<tr>
<td>Insertion time (sec)**</td>
<td>19 (7)</td>
<td>27 (17)</td>
<td>0.003 (Difference: 8; 95% CI: 3 to 13)</td>
</tr>
<tr>
<td>Leak pressure (cm H₂O)**</td>
<td>23 (7)</td>
<td>21 (8)**</td>
<td>0.14 (Difference: 2; 95% CI: -1 to 6)</td>
</tr>
</tbody>
</table>
Randomized prospective trial comparing two supraglottic airway devices: i-gel and LMA-Supreme in paralyzed patients
## PSV vs CPAP with LMA

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th></th>
<th>Group 2</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>CPAP*</td>
<td>PSV†</td>
<td>CPAP‡</td>
<td>PSV*</td>
</tr>
<tr>
<td>n</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>PETCO₂ (mmHg)</td>
<td>50 (48–51)</td>
<td>40 (39–41)</td>
<td>50 (48–51)</td>
<td>41 (40–41)</td>
</tr>
<tr>
<td>SpO₂ (%)</td>
<td>96.6 (96.0–97.1)</td>
<td>98.1 (97.8–98.5)</td>
<td>96.7 (96.1–97.3)</td>
<td>98.2 (97.9–98.6)</td>
</tr>
<tr>
<td>LF (%)</td>
<td>1 (0–1)</td>
<td>1 (0–1)</td>
<td>1 (0–1)</td>
<td>1 (0–1)</td>
</tr>
<tr>
<td>MAP (mmHg)</td>
<td>85 (83–87)</td>
<td>85 (83–88)</td>
<td>85 (83–88)</td>
<td>85 (82–88)</td>
</tr>
<tr>
<td>HR (beats/min)</td>
<td>67 (64–70)</td>
<td>67 (64–70)</td>
<td>68 (65–71)</td>
<td>68 (64–72)</td>
</tr>
</tbody>
</table>
Pressure support ventilation

- Patient initiates each breath: RR and Vt.
- Ventilator delivers additional support.
- Minimum number of breaths.
- Degree of pressure support can be increased if RR and Vt are too low.
Gastroesophageal reflux disease

- SAD do not offer protection against the aspiration of gastric contents to the same degree as cuffed tracheal tubes.

- At high risk for aspiration patients:
  - endotracheal intubation rather than SAD placement.

- Mild gastroesophageal reflux disease well controlled with medication (proton-pump inhibitors) (PPIs):
  - Commonly use: SAD
  - Esophageal vents SAD devices
Obese

- Obese: higher risk for difficult airway management, including difficulty with SAD.
- Obese patients require higher peak inspiratory pressures vs normal-weight patients.
- Higher risk for SAD devices:
  - Inadequate ventilation
  - Leak around the device
  - Gastric insufflation.
Supraglottic airway devices versus tracheal intubation for airway management during general anaesthesia in obese patients
Supraglottic airway devices versus tracheal intubation for airway management during general anaesthesia in obese patients

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>PI(MA) N</th>
<th>Mean(SD)</th>
<th>TT N</th>
<th>Mean(SD)</th>
<th>Mean Difference (NRM)</th>
<th>Weight</th>
<th>Mean Difference (NRM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 During surgery - before carboxpentoneum</td>
<td>35</td>
<td>98.3 (1.2)</td>
<td>35</td>
<td>97.8 (1.4)</td>
<td>-0.50 [ -1.11, 0.11 ]</td>
<td>100.0%</td>
<td>0.50 [ -0.11, 1.11 ]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>35</td>
<td></td>
<td>35</td>
<td></td>
<td></td>
<td>100.0%</td>
<td>0.50 [ -0.11, 1.11 ]</td>
</tr>
<tr>
<td>Heterogeneity not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 1.60 (P = 0.11)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2 During surgery - during carboxpentoneum</td>
<td>35</td>
<td>97.8 (1.3)</td>
<td>35</td>
<td>97.7 (1.6)</td>
<td>-0.10 [ -0.58, 0.78 ]</td>
<td>100.0%</td>
<td>0.10 [ -0.58, 0.78 ]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>35</td>
<td></td>
<td>35</td>
<td></td>
<td></td>
<td>100.0%</td>
<td>0.10 [ -0.58, 0.78 ]</td>
</tr>
<tr>
<td>Heterogeneity not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Test for overall effect: Z = 0.29 (P = 0.77)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 During surgery - after carboxpentoneum</td>
<td>35</td>
<td>98 (1.5)</td>
<td>35</td>
<td>97.6 (2.4)</td>
<td>0.40 [ -0.54, 1.34 ]</td>
<td>100.0%</td>
<td>0.40 [ -0.54, 1.34 ]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>35</td>
<td></td>
<td>35</td>
<td></td>
<td></td>
<td>100.0%</td>
<td>0.40 [ -0.54, 1.34 ]</td>
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<tr>
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<tr>
<td>Test for overall effect: Z = 0.84 (P = 0.40)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4 in IAICU</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Caron 2012</td>
<td>35</td>
<td>96.4 (2.5)</td>
<td>35</td>
<td>94.7 (1.2)</td>
<td>4.37 [ 0.25, 3.05 ]</td>
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<td>4.37 [ 0.25, 3.05 ]</td>
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<tr>
<td>Zoremba 2009</td>
<td>67</td>
<td>93.5 (2.2)</td>
<td>67</td>
<td>90.3 (2.8)</td>
<td>3.20 [ 2.35, 4.05 ]</td>
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<td>3.20 [ 2.35, 4.05 ]</td>
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<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>102</td>
<td></td>
<td>102</td>
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<td>2.54 [ 1.09, 4.00 ]</td>
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<tr>
<td>Heterogeneity: tau^2 = 0.79, Chi^2 = 3.41, df = 1 (P = 0.06); I^2 = 71%</td>
<td></td>
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<tr>
<td>Test for overall effect: Z = 3.42 (P = 0.00063)</td>
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<td></td>
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<tr>
<td>5 After surgery - 30 minutes</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Zoremba 2009</td>
<td>67</td>
<td>94.7 (2.1)</td>
<td>67</td>
<td>92.4 (2.2)</td>
<td>2.30 [ 1.57, 3.03 ]</td>
<td>100.0%</td>
<td>2.30 [ 1.57, 3.03 ]</td>
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<td><strong>Subtotal (95% CI)</strong></td>
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<td>2.30 [ 1.57, 3.03 ]</td>
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<tr>
<td>Test for overall effect: Z = 6.19 (P &lt; 0.00001)</td>
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<tr>
<td>6 After surgery - 7 hours</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoremba 2009</td>
<td>67</td>
<td>95.2 (2.1)</td>
<td>67</td>
<td>93.6 (2.3)</td>
<td>1.60 [ 0.85, 2.35 ]</td>
<td>100.0%</td>
<td>1.60 [ 0.85, 2.35 ]</td>
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<td></td>
<td>100.0%</td>
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Supraglottic airway devices versus tracheal intubation for airway management during general anaesthesia in obese patients

- No serious complications or cases of aspiration occurred.
- Postoperative hypoxemia ($O_2$ saturation <92 percent) was less common with LMA use.
Obese and SAD

- Avoid use of SAD: BMI > 35 kg/m².
- When surgery will last longer than 90 minutes.
- Patients placed in the lithotomy position.
- When access to the airway will be limited during the procedure.
Postoperative Respiratory Complications of Laryngeal Mask Airway and Tracheal Tube in Ear, Nose and Throat Operations
SAD during CPR
Evaluation of six different airway devices regarding regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR)

A human cadaver pilot study.

Endotracheal intubation:
in order to secure adequate oxygenation and ventilation,
to avoid aspiration of gastric contents or blood.
Evaluation of six different airway devices regarding regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR)

A human cadaver pilot study.

Endotracheal intubation:
- in order to secure adequate oxygenation and ventilation,
- to avoid aspiration of gastric contents or blood.

Performing ETI:
- requires high levels of skills and experience
- regular training and practice.
Evaluation of six different airway devices regarding regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR)

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Endotracheal intubation:
- in order to secure adequate oxygenation and ventilation,
- to avoid aspiration of gastric contents or blood.

Performing ETI:
- requires high levels of skills and experience
- regular training and practice.

Potential risks associated with out-of-hospital ETI:
- pulmonary aspiration,
- transfer delay of the patient to the hospital due to the need of several (maybe even unsuccessful) intubation attempts or unrecognized (esophageal) tube misplacement
Evaluation of six different airway devices regarding regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR)

A human cadaver pilot study.

1. Bag valve ventilation (BVV, Ambu Spur II, Bad Nauheim, Germany).
2. Laryngeal tube disposable, size 4 (LT, King-LTS-D, VBM, Sulz, Germany).
3. EasyTube® , Ch 41 (ET, Teleflex Medical Ruesch, Research Triangle Park, NC).
6. Laryngoscopy-guided endotracheal intubation (ETI) using a tube with 7.5mm inner diameter (Mallinckrodt, Athlone, Ireland) reinforced with a Single-use malleable intubation stylet (SmithsMedical, Brunn am Gebirge, Austria).
Evaluation of six different airway devices regarding regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR)

A human cadaver pilot study.

-“Regurgitation”:
  the presence of methylene-blue-solution (as a measure of gastric content) in the esophagus and/or the laryngopharynx.

-Pulmonary “aspiration”:
  the presence of methylene-blue-solution (i.e. gastric content) below the vocal cords or below the tube cuff in patients intubated with ETI.
Evaluation of six different airway devices regarding regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR)

A human cadaver pilot study.
Evaluation of six different airway devices regarding regurgitation and pulmonary aspiration during cardio-pulmonary resuscitation (CPR)

A human cadaver pilot study.

-No signs of aspiration in human cadavers, whose airways had been secured using ETI or EasyTube.

-ETI is superior to alternate (supraglottic) airway devices or BVV in terms of protection against aspiration during ongoing CPR.

-ETI as well as the EasyTube offer superior protection against aspiration, if regurgitation occurs.
SAD and Prone Position
Laryngeal mask in prone position: pure exhibitionism or a valid technique.

- A prospective study,
- 50 patients,
- Ambulatory surgery in the prone position.
Laryngeal mask in prone position: pure exhibitionism or a valid technique.

<table>
<thead>
<tr>
<th></th>
<th>Induced before</th>
<th>Induced after</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prone positionning</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>T Induction-incision (min)</td>
<td>23.6 +/- 3.6 (range 21-37)</td>
<td>7 +/- 2.44 (range 5-15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>p &lt; 0.0001</td>
</tr>
</tbody>
</table>
| Man power positionning   | 3.12 +/- 0.6 (range 2-4)      | 1.0 (p < 0.0001)             

Minerva Anesthesiol. 2007 Jan-Feb;73(1-2):33-7
Laryngeal mask in prone position: pure exhibitionism or a valid technique.

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<td>Man power positioning</td>
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</tr>
</tbody>
</table>

No complications nor airway loss when LMA was used in the prone position.

Group 2 (after) showed significantly more favorable hemodynamic parameters.
Comparison of the I-gel laryngeal mask airway with the LMA-supreme for airway management in patients undergoing elective lumbar vertebral surgery.

- Prospective study:
  - i-gel vs LMA Supreme.
  - Patients undergoing back surgery.

- SAD inserted: supine.
Comparison of the I-gel laryngeal mask airway with the LMA-supreme for airway management in patients undergoing elective lumbar vertebral surgery.

- Prospective study:
  - i-gel vs LMA Supreme.
  - Patients undergoing back surgery.

- SAD inserted: supine.

- i-gel required more attempts at insertion

- i-gel provided a higher airway seal pressure.

- No difference was observed in the fiberoptic views of the vocal cords.
Comparison of the I-gel laryngeal mask airway with the LMA-supreme for airway management in patients undergoing elective lumbar vertebral surgery.

- Prospective study:
  - i-gel vs LMA Supreme.
  - Patients undergoing back surgery.

- SAD inserted: supine.

- i-gel required more attempts at insertion

- i-gel provided a higher airway seal pressure.

- No difference was observed in the fiberoptic views of the vocal cords.

- Both devices may also be used safely in airway management of patients undergoing lumbar surgery in the prone position.

*J Neurosurg Anesthesiol.* 2015 Jan;27(1):37-41
SGA placement may predispose to regurgitation:
-relaxing the lower esophageal sphincter via a reflex mechanism similar to that which occurs with swallowing a bolus of food.
Esophageal reflux with SGAs

- 40 patients under general anesthesia
- Laryngeal mask placement was associated:
  - 15% decrease in lower esophageal sphincter barrier pressure.
  - pH electrodes in the esophagus compared pH evolution between facemask vs LMA:
    - Increase in reflux of stomach acid
    - To mid upper esophagus.
Prevention of aspiration

- SAD may act as a plug to prevent aspiration of esophageal contents into the lungs.
- Vomiting or increase in abdominal pressure can overcome the capacity of the SGA to prevent pharyngeal reflux.
Prevention of aspiration

Cadaver studies

<table>
<thead>
<tr>
<th>Device</th>
<th>LMA classic</th>
<th>LMA Proseal (vent clamped)</th>
<th>LMA Proseal (vent open)</th>
<th>I Gel (esophageal lumen clamped)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure regurgitation (cmH2O)</td>
<td>40-48</td>
<td>70</td>
<td>Any increase in esophageal pressure</td>
<td>13</td>
</tr>
</tbody>
</table>

*Br J Anaesth 2009; 102: 135–9*
Prevention of aspiration

<table>
<thead>
<tr>
<th>Device</th>
<th>Pressure regurgitation (cmH2O)</th>
<th>LMA Proseal (vent clamped)</th>
<th>LMA Proseal (vent open)</th>
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<td>40-48</td>
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<td>Any increase in esophageal pressure</td>
<td>13</td>
</tr>
<tr>
<td>cLMA Device (clamped)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cLMA Device (open)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pLMA</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Prevention of aspiration

- Prospective study of 102 patients under general anesthesia
- SAD: LMA ProSeal
- Dyed saline was introduced down the esophageal vent of the LMA
- Fiberoptic laryngoscopy showed no transfer of the dye into the bowel of the LMA in 100 patients.
- In 2 patients: dye appeared in the bowl after increased intraabdominal pressure (cough or laryngospasm)
Prevention of aspiration

- Select the patient and surgical procedure,
- Consider risk factors for aspiration:
  - duration of surgery,
  - surgical site, and
  - positioning.
- Adequate depth of anesthesia for insertion of the SGA and during surgery.
- Ensure adequate reversal of neuromuscular blockade prior to emergence from anesthesia.
- Minimize peak airway pressure during positive pressure ventilation (PPV) in order to avoid gastric insufflation and distention.
**Airway complications**

- Unusual,
- Airway-related critical incident rate: 0.15 %
- Potential airway complications include:
  - Irritation of the oropharyngeal mucosa (especially with excessive cuff pressures).
  - Injury to teeth, tongue, and lips at the time of insertion.
  - Injury to the glottic structures (eg, epiglottis, arytenoids).
  - Negative pressure pulmonary edema.
  - Pharyngolaryngeal rupture and pneumomediastinum (rare)
  - Laryngospasm (less common at extubation with SGAs than with ETTs, but unlike ETTs).
Injury to the glottic structures

Mucosal Erosion of the Cricoid Cartilage in a patient with Diffuse Idiopathic Skeletal Hyperostosis
Injury to the glottic structures

Mucosal Erosion of the Cricoid Cartilage in a patient with Diffuse Idiopathic Skeletal Hyperostosis

A&A Case Reports. 2014;3:45–7
Cranial nerve injuries with supraglottic airway devices
Cranial nerve injuries with supraglottic airway devices
Cranial nerve injuries with supraglottic airway devices

Infra-orbital nerve

Lingual nerve

Inferior alveolar nerve

Hypoglossal nerve

Mental nerve

Hyoid bone

C6

Recurrent laryngeal nerve

Thyroid cartilage

Oesoph.

Trachea

Third molar

Lingual plate

Lingual nerve

Anaesthesia 2015, 70, 344–359
Cranial nerve injuries with supraglottic airway devices

Number of records identified from PubMed and Embase (n = 355)

Duplicates removed (n = 45)

Relevant articles screened (n = 313)

Excluded: Based on title and abstract (n = 222)

Full text articles assessed for eligibility (n = 91)

Excluded (n = 38)
- Not meeting the Inclusion criteria (n = 37)
- Unable to get Japanese abstract (n = 1)

Reports included (n = 53)
- (Includes abstract only data from 3 Japanese and one Danish report)

Trigeminal nerve
- Reports (n = 23)
  - Patients (n = 25)
  - Lingual (n = 22)
  - Inferior alveolar (n = 2)
  - Infra-orbital (n = 1)

Recurrent laryngeal nerve
- Reports (n = 16)
  - Patients (n = 17)

Hypoglossal nerve
- Reports and patients (n = 11)

Glossopharyngeal nerve
- Patients (n = 3)
Cranial nerve injuries with supraglottic airway devices

Identification

Number of records identified from PubMed and Embase (n = 355)
Records identified through manual search (n = 3)

Duplicates removed (n = 45)

Included

Trigeminal nerve
Reports (n = 23)
Patients (n = 25)
Lingual (n = 22)
Inferior alveolar (n = 2)
Infra-orbital (n = 1)

Recurrent laryngeal nerve
Reports (n = 16)
Patients (n = 17)

Hypoglossal nerve
Reports (n = 11)

Glossopharyngeal nerve
Patients (n = 3)

Data from 3 Japanese and one Danish report
Recurrent laryngeal nerve injuries

- Oarseness
- Tongue deviation
- Shortness of breath
- Dysphonia
- Inspiratory stridor
- Dysphagia
- Aphonia
- Laryngeal incompetence
- Fluid aspiration
- Laryngeal oedema
- Vocal cord bowing to right
Trigeminal nerve injuries

Numbness

Taste disturbance

Swelling, (midline upper lip)

Lower lip numbness

Lower lip numbness and ulcer
Hypoglossal nerve injuries

- Tongue deviation
- Dysarthria
- Fasciculations & motor weakness
- Tongue numbness
- Dysphagia
Contributing factors to cranial nerve injuries

- Anaesthesia-related factors:
  - Excessive cuff inflation, > 60 cm H2O
  - Failure to measure and adjust the cuff pressure
  - Inappropriate size selection
  - Peri-operative manipulation of the device
  - Nitrous oxide use
  - Malpositioning
  - Traumatic insertion
  - Poor technique
  - Chemical neuronitis

- Patient-related factors
  - Diabetes mellitus
  - Collagen vascular disorders
  - Peripheral vascular disorders

- Surgery-related factors
  - Lateral position
  - Extreme head rotation
  - Prone position
  - Prolonged duration
Use of Manometry for Laryngeal Mask Airway Reduces Postoperative Pharyngolaryngeal Adverse Events
A Prospective, Randomized Trial
Supraglottic airway cuff pressure gauge

• Use of manometry:
  ● Maintain cuff pressure < 44 mmHg versus standard cuff inflation.
  ● Lower incidence of pharyngolaryngeal adverse events:
    ● 13.4 versus 45.6%.
Supraglottic airway cuff pressure gauge

<table>
<thead>
<tr>
<th></th>
<th>1 h</th>
<th></th>
<th>2 h</th>
<th></th>
<th>24 h</th>
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<tbody>
<tr>
<td></td>
<td>Pressure Limiting (n = 97)</td>
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<tr>
<td>Sore throat (%)</td>
<td>7.2</td>
<td>7.8</td>
<td>2.1*</td>
<td>8.7</td>
<td>3.1*</td>
<td>13.6</td>
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<tr>
<td>*P value</td>
<td>0.883</td>
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<td>0.038</td>
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<td>0.008</td>
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<tr>
<td>Dysphagia (%)</td>
<td>1*</td>
<td>12.6</td>
<td>0*</td>
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<td>&lt;0.001</td>
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<tr>
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<td>5.2*</td>
<td>15.5</td>
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*Denotes significance at the 0.05 level.
## Supraglottic airway cuff pressure gauge

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<tr>
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</tr>
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<td>( P ) value</td>
<td>0.407</td>
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# Supraglottic airway cuff pressure gauge

<table>
<thead>
<tr>
<th></th>
<th>Pressure Limiting (n = 97)</th>
<th>Routine Care (n = 103)</th>
<th></th>
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<td></td>
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*Statistically significant.
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New supraglottic airway with built-in pressure indicator decreases postoperative pharyngolaryngeal symptoms: a randomized controlled trial

Y (yellow) <30 mmHg
G (green) = 30 - 44 mmHg
R (red) > 51 mmHg

Colour pressure-indicator zones
Cuff pressure

- Use of manometry:
  - Built-in cuff pressure monitor vs standard cuff inflation, monitoring.
Cuff pressure

![Graph showing incidence of dyphonia over time.](image)
Cuff pressure

![Graph showing incidence of dysphonia over time](image-url)
Cuff pressure

![Graph showing the incidence of sore throat over time]

- **1h**: 26%*
- **2h**: 13%*
- **24h**: 5%*
Cuff pressure

• Use of manometry:
  • Built-in cuff pressure monitor vs standard cuff inflation, monitoring.
  • Lower combined rates of sore throat, dysphonia, and dysphagia at 1, 2, and 24 hours postoperatively
    26 versus 49%.
Conclusion

• Choose the right patient
• Choose the right device
• Monitor the cuff pressure around 40 cmH$_2$O
• Or to the minimum pressure needed to create an adequate seal
• PPV or PSV: with Peak pressures < 20 cmH$_2$O
• Rescue device
• “New indications”: obese, prone, …
• Still complications …
SimUSanté® ouvre ses portes
Première journée pédagogique

Mercredi 24 février 2016

zogheib.elie@chu-amiens.fr
KFARDEBIAN LEBANON