**WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care**

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<th>Worksheet author(s)</th>
<th>Date Submitted for review:</th>
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<tr>
<td>Enrique Udaeta</td>
<td>December 3, 2009</td>
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**Clinical question.**

For newborns requiring positive pressure ventilation (P), is LMA (I) an effective alternative to mask or endotracheal ventilation (C) for improving outcome (O)? (achieving stable vital signs and reducing the need for subsequent endotracheal intubation)?

**Is this question addressing an intervention/therapy, prognosis or diagnosis?**: Intervention/therapy

**State if this is a proposed new topic or revision of existing worksheet**: Revision of existing worksheet

**Conflict of interest specific to this question**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No

**Search strategy (including electronic databases searched).**

- Pub Med [http://www.ncbi.nlm.nih.gov/PubMed/](http://www.ncbi.nlm.nih.gov/PubMed/), “Laryngeal Masks or Laryngeal Mask, or Laryngeal Mask Airway or LMA” AND “Infant or Newborn or Neonate” as MESH (headings) AND “cardiopulmonary resuscitation or neonatal resuscitation or resuscitation” text word in abstract. Intubation, intra$. Mp or exp Intubation, Intratracheal as MeSH Headings) EMBASE search using text words (all fields) Laryngeal Masks AND Newborn or Infant AND Resuscitation
- AHA EndNote X1 Master library [http://ecc.heart.org/](http://ecc.heart.org/), Cochrane database for systematic reviews, Central Register of Controlled Trials[http://www.cochrane.org/](http://www.cochrane.org/), Review of references from articles. Forward search using SCOPUS and Google Scholar. All languages included

**State inclusion and exclusion criteria:**

**Inclusion:**

- P: (1) Term or preterm infants who required positive pressure ventilation for cardiopulmonary resuscitation due to any cause during the first 30 days of life.
- (2) Term or preterm infants who required positive pressure ventilation for cardiopulmonary resuscitation due to any cause during the first 30 days of life, where face-mask ventilation was found to be either insufficient or ineffective.

- I: (1) LMA used for initiating positive pressure ventilation, with any insertion technique, for neonatal cardiopulmonary resuscitation compared with face-mask ventilation.
- (2) LMA used as a secondary airway device, with any insertion technique, for neonatal cardiopulmonary resuscitation, when face-mask ventilation was found to be insufficient or ineffective, compared with endotracheal intubation.

Prospective, controlled clinical trials were included without language restrictions. Observational studies describing the LMA used for human neonatal resuscitation that did not include a control group (case series, case reports) were assigned to LOE 5

**Exclusion:** Animal studies excluded. Adult and pediatric human resuscitation studies were excluded

Studies describing neonatal subjects combined with older infants were excluded if insufficient details were available to independently assess outcomes for the neonatal subgroup.

Studies describing the LMA used for anesthesia, to facilitate endotracheal intubation, or to facilitate diagnostic bronchoscopy were excluded if the subject was breathing spontaneously through the LMA without positive pressure ventilation.

Information published in abstract form, letters to editor and articles not yet accepted for publication were excluded.

**Number of articles/sources meeting criteria for further review:**

Articles evaluated for this worksheet until August 31 2009, 28. Included in the greed: three with LOE 1, one with LOE 2, three with LOE 4, and two with LOE 5.
## Summary of evidence

### Evidence Supporting Clinical Question

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<thead>
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<th>Fair</th>
<th>Poor</th>
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### Evidence Neutral to Clinical Question

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### Evidence Opposing Clinical Question

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### Level of evidence

- **A** = Return of spontaneous circulation
- **B** = Survival of event
- **C** = Survival to hospital discharge
- **D** = Intact neurological survival
- **E** = Other endpoint

*Italics = Animal studies*
REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

DISCUSSION:
I have modified the question because of a need to further define the patient population and the intervention. The re-written question, with the modification in italics is:

“For newborns requiring positive pressure ventilation (during neonatal resuscitation), is LMA an effective (and safe) alternative to mask or endotracheal ventilation (as a primary or secondary device) for improving outcome (achieving stable vital signs and reducing the need for subsequent endotracheal intubation)

Neonatal Resuscitation

In Delivery Room (DR)
Eleven potentially eligible studies were identified. Three randomized controlled trials, one Cochrane review, two systematic reviews, three case-series and two mechanical models. In these studies, all patients were near term or term infants.

Randomized studies
- At the present time, the best available evidence evaluating the efficacy and safety of the LMA for neonatal cardiopulmonary resuscitation comes from three small randomized controlled trials (Esmail 2002, p.115; Singh 2005, p.303, Feroze 2008, p.148)
- LMA as a primary device
- A small-RCT (LOE 1, Singh 2005, p.303) in newborns requiring positive pressure ventilation during neonatal resuscitation that compare the effectiveness and safety of the LMA versus FMV, as the primary device for improving outcome (achieving stable vital signs and reducing the need for subsequent endotracheal intubations). This study randomized 50 term infants with apnea lasting more than 30 seconds or Apgar score at one minute less than 6 or heart rate less than 100/minute after 30 seconds using the ILCOR 2000 algorithm for neonatal resuscitation. Patients with meconium in amniotic liquid, birth weight less than 1.5 Kg, gestational age less than 35 weeks, congenital diaphragmatic hernia and tracheo-oesophageal fistula were excluded. There were no differences in LMA (25 patients) vs. FMV (25 patients) for improving outcome (achieving stable vital signals), but there was a trend toward better results with the LMA vs. FMV in successful ventilation (0.96 vs. 0.88), RRA -.08 (IC 95% -.2285 to .0685), NNT 12.5, but without significance (p= 0.7). The group ventilated with LMA had less gastric distention than the group with FMV (0.12 vs. 0.28) respectively, RRA .16 (CI 95% .38 to .06) NNT 6.25. There were no significant differences between the groups in reducing need for subsequent endotracheal intubation, duration of positive pressure ventilation, or lower inflation pressure for chest rising. The Pink-Up time (time required from initiation of ventilation to the disappearance of central cyanosis) was similar in both groups. The time to insertion of the LMA was very short (10.5; 7 - 32 sec.), and the success at the first attempt was relatively lower 80%. The limitations of this study are: was a pilot study (small number of cases), the randomization method was not stated, and two anesthesiologists with experience in LMA did all insertions. In summary, this trial suggests that the LMA and FMV may be equivalent, among experienced operators, for establishing effective ventilation as a primary device during neonatal resuscitation.
- The small-RCT study (LOE 1, Feroze 2008, p.148) in 75 newborns requiring positive pressure ventilation during neonatal resuscitation delivered by C-section that compared the effectiveness of LMA versus ETT and FMV as a primary device for artificial ventilation, was done in newborns more than 1,500g with no maternal complications showed a better results in the LMA group for successful procedure (failure 1/25 vs. 2/25 for ETT). The number of attempts required for insertion for LMA was one to two and the time for insertion was 9 seconds for LMA vs. 9.5 for ETT. The Pick Up Time was 1-2 minutes in LMA group compared to 1.5-2.5 in ETT group and 2.5-3 minute in FMV. The duration of PPV was 80 (30-300) seconds in the LMA group. The limitations of this study are: small number of cases, not enough information on newborns, the randomization method was not stated and all insertions were done by anesthesiologists (not mentioned number). This trial suggests that the LMA and FMV and ETT may be equivalent, among experience operators, for establishing effective ventilation as a primary device during neonatal resuscitation.

- LMA as a secondary device
- There is only one single small-RCT (LOE 1, Esmail 2002, p.115) directly comparing neonatal resuscitation effectiveness and safety of the LMA versus ETT as a secondary airway device when face-valve-mask was unsuccessful. This study randomized 40 newborns > 35 weeks gestation and > 2500 grams delivered following
Caesarean section to size-1 LMA placement (n=20) or ETT (n=20) if they had not responded (HR < 100 bpm) to FMV within one minute. The operator was an anesthesiologist in all cases. Successful placement at the first attempt was similar in both groups. The time to insertion in seconds was slightly shorter with an ETT compared with an LMA (7.5 seconds vs. 10 seconds, p<0.05), but overall time to insertion was very short. There was no difference in overall success rate, LMA (17/20) or ETT (18/20). The time to achieve a normal heart rate, color and spontaneous respiratory effort, or Apgar scores was similar in both groups. There was no statistically significant difference in traumatic events involving the epiglottis and uvula (6/20 LMA, 3/20 ETT). The limitations in this study are the absence of details describing the randomization method and the inclusion of only normal birth-weight infants following a Caesarean section, the operators in this trial were all anesthesiologists and may have biased the trial against finding a difference between the LMA and ETT. In summary, this trial suggests that the LMA and ETT may be equivalent, among experienced operators, for establishing effective ventilation if attempts with a face-mask device have been unsuccessful.

Cochrane Review

- The Cochrane Review (LOE 1, Grein 2005) found one randomized controlled trial (LOE 1, Esmail 2002, p.115) comparing laryngeal masks airway versus endotracheal tube as a secondary airway device when face-valve-mask was unsuccessful. The conclusion was that there was "no clinical differences between the devices". Also this review included several observational studies suggesting that the LMA can provide a rescue airway and achieve effective positive pressure ventilation during resuscitation of the newborn infant if both FMV and ETT have been unsuccessful.

Systematic Reviews

- A review (LOE 5 Udaeta 2006, p. 99) included the studies as the Cochrane Review and also observational studies (multiple case reports or extrapolation from operating room experience) and recommends attempting ventilation with LMA during neonatal resuscitation when FMV en ETT have failed as an airway emergency.

Case-series

- Since the last review (W215A- Weiner and W215B Udaeta, ILCOR Guidelines 2005, p. 293) others two case series after LOE 4 Gandini 99, p. 642, and LOE 4 Paterson 94, p. 1248 have been published using LMA as a primary device in neonates requiring PPV in delivery room during neonatal resuscitation (LOE 4, Trevisanuto 2004, p. 151; LOE 2, Zanardo 2004, p. 228). However, these new studies have limitations; all were non-randomized observational studies. Trevisanuto 2004 was a retrospective study of 74 patients resuscitated with LMA and compared both historical and concurrent group of 74 patients (age-matched controls) resuscitated with facemask. The gestational age for both groups was equal or more than 34 weeks, and the birth weight was equal or more than 2000g. The duration of PPV was 74 (32-905) in the LMA group. The decision to use an LMA or ETT was resuscitator’s choice. Zanardo 2004 was a retrospective cohort study comparing the rate of neonatal depression between caesarean section and vaginal delivery. At the same time, the authors compared newborns resuscitated with LMA (43 patients) vs. ETT (18 patients) following either caesarean section or vaginal delivery. The patients in both groups were equal or more than 37 weeks. The decision to use LMA or ETT was resuscitator’s choice. It seems that Zanardo 2004 reports some of the patients reported by Trevisanuto 2004.

- There are no data to evaluate laryngeal mask airway in the setting of meconium-stained amniotic fluid or chest compression during neonatal resuscitation.

In Operating room (OR) or Neonatal Intensive Care Unit (NICU)

Since 2002, there have been 15 reports with sixteen cases (one thoracopagus) in which the LMA was used during resuscitation in the OR or the NICU as a life-saving rescue airway device after both FMV and ETT failed (Ali 2005, Asia 2008, p.890: Baker 2004, p. 781; Brimacombe 2004, p. 188; Bucx 2003, p. 530; Cain 2006, p.1274; Castilla 2004, p. 172; Fernandez-Jurado 2002, p. 369; Gandini 2003, p. 181; Leal-Pavey 2004, p. 427; Matveevskii 2006, p. 322; Shank 2005, p. 361; Somri 2005, p. 268; Stocks 2002, p. 223; Trevisanuto 2005, p.e109, Yao 2004, p. 97). Long-term use of LMA (from 44 hours to eight days) in newborns, with difficult airway and supplemental oxygen requirements (three cases), nasal CPAP (one case), and mechanical ventilation (one case) has been reported. None of these studies were included because all were Case report and are identified as “Addendum Citation List for Case report”. There was one case series (8 cases) LOE 5, (Trevisanuto 2005, p. 217) using the LMA as a device to administer endotracheal surfactant in small babies with SDR in nasal CPAP with success.

Manikin Model

2002 two studies have been published using manikins. One compared successful placement of a LMA by inexperienced health workers who had received a short training period of approximately 15 minutes. The time required to insert the LMA was 5 (range 5 to 16) seconds with no failures and resulted in increasing confidence for use of the LMA from 6 to
80% (LOE 5, Gandini 2004, p. 493). Another study with 35 health workers with no previous experience and fifteen minutes of instruction with up to 4 insertion attempts with each device, compared classic LMA (cLMA) vs. Proseal LMA (pLMA). There were no failed insertions after three attempts and the insertion time was reduced after four attempts for cLMA (LOE 5, Micaglio 2006, p. 1028).

Acknowledgements:
Dr Carlos Lopez Candiani from Instituto Nacional de Pediatria, Mexico, for his assistance in statistics

Citation List


Critique: Level 1, fair. Randomized concurrent control. Support. Resuscitation in delivery room. LMA vs. ETT. This study randomized 40 newborns delivered by C-section to size-1 LMA or endotracheal tube. All were more than 35 weeks and equal or more 2500 gr. weight, with Apgar score 0-3 at 1 minute despite positive pressure ventilation by face mask. Were excluded known anomalies or need for chest compressions. Three anesthesiologists resuscitated the infants and the airway was examined with a laryngoscope afterwards to confirm placement and assess trauma. The time to insertion in seconds was slightly faster with an ETT compared with a LMA, but overall time to insertion was very short. There was no difference in overall success rate and one infant required 3 attempts to insert the LMA. Also, there were no differences in the time to a normal heart rate, color and spontaneous respiratory effort, or Apgar scores. There was more soft tissue trauma with the LMA (2 subjects) than ETT (1 subject). The LMA was connected to a T-piece circuit. When the heart rate was greater than 100 bpm and spontaneous breathing was beginning, continuous positive airway pressure was provided until the neonate was breathing adequately and the LMA or ETT and CPAP then was removed. The method of randomization was not stated.


Critique: Level 1, poor. Randomized concurrent control. Support. Resuscitation in Delivery Room
This study compared 75 newborn infant delivered by C-section, 25infants for ETT, 25 for FMV, and 25 for LMA #1. All deliveries were attended for residents in anesthesia with training in neonatal resuscitation. The inclusion criteria were birth weight more than 1,500g, Apgar score less than 4 at birth and without maternal disease. Neonates with birth trauma were excluded. The average time to insert the ETT was 9.5 seconds vs. 9 seconds for LMA. The number of attempts was 2-3 for ETT group and 1-2 for LMA group. The time for Pick Up Time in seconds was for ETT 35-40, for FMV 45-50 and for LMA 30-35. The time required for effective resuscitation was in minutes for ETT 1.5- 2.5, for FMV 2.5- 3, and for LMA 1-2. In 1/24 cases in the LMA group needed ETT insertion. The Apgar score at five minutes was better in the LMA group. No gastric distension was reported in any group. The method of randomization was not stated,


80 Health care workers (anesthesiologist, pediatricians, nurses and midwives) with no previous experience were trained on a manikin bases with the LMA for neonatal resuscitation. After training the mean (SD) range time to insert the LMA was 5 (2, 5-16) seconds with no fails; the students changed from 72 to 14% for face mask (P <0.00001), from 6 to 80% for the LMA (P <0.00001), from 5 to 0% ETT with laryngoscope (P =0.04); The confidence for use the LMA was from 6 to 80% (P <0.00001). The didactic and practice training was brief (less than 15 min); there was not control group with ETT. Even there were no fails and the confidence was very high, is not possible to assure the successful with the LMA in the manikin as with the live patient during a complicated neonatal resuscitation. Also there was not practice with different scenarios in the manikin model (patient in apnea or no heart rate increase, need of medications, etc.).


Part of these results was published previously in Pediatrics in a Letter to the Editor (1995;95:453-4). This is a prospective observational study to evaluate LMA use by a single pediatric resident during 5 years. The data were comparative between normal newborn vs. LBW and obviously there were statistical differences. All patients who required PPV for apnea or heart rate < 100 bpm
were included, using LMA. Neonates with meconium-stained fluid and evidence of meconium aspiration were excluded if they had evidence of meconium aspiration. All insertions were performed by one anesthesiologist. Size 1 LMA was inserted and connected to a T-piece circuit. The airway pressure was limited to 40 cmH2O. If the neonate required PPV for > 15 minutes, the LMA was removed and the trachea was intubated. 75 Term and 29 LBW infants were included. 103 (99%) neonates were successfully resuscitated. The lowest birth weight was 1.0 Kg and 6 were < 1.5 Kg. LBW required PPV > 15 min, 6 neonates delivered by c-section under general anesthesia required LMA reinsertion due to central hypoventilation, and 6 resuscitated with an LMA subsequently developed respiratory distress syndrome and required nasopharyngeal CPAP.


**Critique:** Level 1, good; Cochrane Systematic Review. Support. Resuscitation

This Cochrane systematic review was restricted to randomized and quasirandomized trials. The review excluded evidence from observational studies and included only the single reported randomized controlled trial (Esmail 2002), but the authors conclude that most of the evidence evaluating the use of laryngeal masks for neonatal cardiopulmonary resuscitation comes, from observational studies and suggests that the LMA can provide a rescue airway and achievable pressure ventilation during resuscitation of the newborn infant if both FMV and ETT have been unsuccessful. Although the evidence supporting this conclusion is largely from extrapolation and based on case reports, the non-invasive nature of LMA placement in comparison with the alternative (tracheotomy), and the practical difficulties of designing a randomized controlled trial in this unpredictable emergency situation make it unlikely that definitive evidence will become available. As a result, the Cochrane review has limited scope and may not consider the “best available” evidence.


**Critique:** Level 5 good, Practice guideline, Consensus on science. Support. Resuscitation.

The ILCOR mentions that masks that fit over the laryngeal inlet are effective for ventilating newborn term infants (LOE 2; LOE 5). There are limited data on the use of these devices in small preterm infants (LOE 5). There is currently no evidence directly comparing the laryngeal mask airway with face-mask ventilation during neonatal resuscitation and, concludes that the laryngeal mask airway may enable effective ventilation during neonatal resuscitation if face-mask ventilation is unsuccessful and tracheal intubation is unsuccessful or not feasible. There is insufficient evidence to recommend use of the laryngeal mask airway as the primary airway device during neonatal resuscitation or in the settings of meconium-stained amniotic fluid, when chest compressions are required, or for the delivery of drugs into the trachea. This recommendations are based on a different methodology as the Cochrane reviews, because includes most of studies not only randomized or quasirandomized and are made on consensus.


**Critique:** Level 5 fair; Mechanical model. Support. Resuscitation training.

35 Healthcare workers (nine anesthesiologist, five neonatologists, seven pediatric residents, eight nurses, two midwives, and four gynecologists) of a regional Level III center received training on a single manikin in insertion with classic LMA and ProSeal LMA for four times each one with 15 minutes practice each one device. There were no failed insertions after 3 attempts, and the insertion time was reduced for the fourth intent (P <0.01) especially for the classic LMA. The didactic and practice training was brief. Even there were no fails, is not possible to assure the successful with the LMA in the manikin as with the live patient during a complicated neonatal resuscitation. Also there was not practice with different scenarios in the manikin model (patient in apnea or no heart rate increasing, need of medications, etc.).


**Critique:** Level 4, fair Case series, Support. Resuscitation

This study included neonates > 2.5 Kg and > 35 weeks gestation and the need for resuscitation including PPV and heart rate < 110 bpm (4 cases) or < 100 bpm (17 cases). The investigators with previous expertise in neonatal resuscitation were trained previously with 24 infants presenting for elective lower abdominal surgery over a period of 4 days. Three persons placed all of the LMA’s. The LMA was connected to a T-piece circuit for PPV. If thick particulate meconium was observed in the pharynx of a depressed neonate the trachea was intubated to allow suctioning of meconium. If the neonate required PPV, the LMA was blindly inserted. 21 neonates met the criteria, 2 neonates required tracheal intubation for suctioning of meconium, the ETT was removed and LMA was inserted. 1 case required epinephrine and chest compressions and the LMA were removed in favor of a tracheal tube. In 20/21 patients after 30 seconds of PPV the heart rate skin color and Apgar score improved. No complications, such as bruising of the oropharynx or edema, were observed. No control group, success in 21/21 with LMA #1 without prior face and mask ventilation.
Critique: Level 1, fair; Randomized concurrent control. Support. Resuscitation on delivery room. LMA vs. FMV.

Fifty neonates in whom neonatal resuscitation was needed were randomly assigned for LMA (25) and for face mask (25). The patients studied were those with apnea lasting more than 30 seconds or Apgar score at one minute less than 6 or heart rate less than 100/minute after 30 seconds. Five practice insertions of LMA (Size 1) were done before the study could begin. The ILCOR 2000 algorithm for neonatal resuscitation was followed. The patients with meconium in amniotic liquid, birth weight less than 1.5 Kg and gestational age less than 35 weeks were excluded (also congenital diaphragmatic hernia and tracheo-oesophageal fistula- author response). The LMA was inserted at the first attempt in 21/25 (80%), but in one case chest rise was not observed after 3 LMA inserts, then an ETT was inserted, a tracheal suction was done and the patient was easily ventilated. Three patient’s required two LMA attempts and one three attempts. In the FMV group 22/25 neonates could be easily ventilated, two required ETT for a successful ventilation, and one case with a difficult airway (cleft lip and palate), after two failed intents of ETT, an LMA was inserted. The mean time required for LMA insertion was 10.5 seconds (10 sec; 7-32 sec). The mean Pink up time (time required from initiation of ventilation to the disappearance of central cyanosis), for LMA was 35.33 (10 sec – 4 min) and for FMV 44.52 seconds (range 11 sec- 4 min. There were no differences in Apgar scores at 1 and 5 minutes between both groups. The duration of PPV was larger in FMV (mean 2.14; range 40 sec – 12 min. than LMA group) (mean 1.76; range 40 sec – 10 min.), and the maximum pressure administered also were more high in the FMV group than LMA group (22 cmH2O vs. 12 cmH2O respectively). In the FMV group gastric distention was more frequently. This is the only Level 2 study comparing FMV and LMA as a first adjunctive device for neonatal resuscitation showing a trend favoring LMA. The limitations are: is a pilot study (small number of cases), the randomization was not stated, and two anesthesiologists with experience in LMA did all insertions.

Critique: Level 4, fair; Case series, retrospectively assembled with both a historical and concurrent group. Support. Resuscitation.

The case series historical of 74 neonates requiring PPV at birth treated with LMA was compared with a concurrent group on 74 newborns resuscitated using a face mask device. All LMA was introduced by 10 physicians with experience in LMA use and was successful in all chosen patients. No differences in Apgar score, need for ETT, transfer to NICU and primary outcomes in both groups. Four patients on FMV group who could not be ventilated were successfully treated with LMA. One case in the LMA group required ETT. There was not randomization, for the allocations to FMV or LMA, it was decided by resuscitator. These patient were included in two other reports by the same authors (Trevisanuto 2004, Zanardo 2004)

Critique: Level 5, fair; Case series. Support. Drug administration.

This a report on 8 premature infants with mean (range): postnatal age of 28 (2-68) hours, gestational age 31 (28- 35) weeks, and birth weight 1,700 (0.800- 2,520) kg, treated with nasal CPAP (5 cm H 2 O) for RDS (grade II or III) with arterial-to-alveolar oxygen tension ratio (a/APO 2) less than 0.20 over a period of more than 60 min., in whom exogenous surfactant was administrated through a LMA size 1. The LMA was left in place by 155 (135-210) seconds, and removed after a good respond on PPV and the patients had spontaneous respirations acceptable the CPAP was resumed. No acute complications were registered and all patients survived. The purpose of this study was avoiding the use of ETT for surfactant administration. All insertions were made by experience personal in LMA use. There was no control group. In smaller patients (less than 1.0 kg) is necessary to evaluate the size of the LMA and the potential risks.

Critique: Level 5 Systematic review, good; Support. Resuscitation.

This was a systematic review on LMA during neonatal resuscitation. The search identified 48 relevant studies, including one Cochrane systematic review (Grein 2003), one small randomized controlled trial (Esmail 2002), two nonrandomized cohort studies (Zanardo 2004, Trevisanuto 2004), three large uncontrolled case series (Trevisanuto 2004, Gandini 1999, Paterson 1994), three mechanical or animal models, and multiple smaller case series or individual case reports for neonatal resuscitation, and other no resuscitation purposes. The Cochrane systematic review was restricted to randomized and quasirandomized trials. The review excluded evidence from Observational studies and included only the single reported randomized controlled trial. Most of the evidence evaluating the use of laryngeal masks for neonatal cardiopulmonary resuscitation comes, however, from observational studies. Based on this information (multiple case reports) the author made a relatively strong recommendation to attempt ventilation with a laryngeal mask during neonatal resuscitation when facemask ventilation and endotracheal intubation have failed. This recommendation comes largely from case reports or extrapolation from operating room experience (weak), so the attempting to placement of a LMA should be during an airway emergency.

**Critique:** Level 2, poor; Case series, retrospectively assembled cohort study. Support. Resuscitation.

This study was done to assess the rate on neonatal depression after elective cesarean section versus vaginally delivery. A subgroup between the neonates required PPV using LMA (43 cases) or ETT (18 cases) was done. Of the cesarean section group 30 cases were managed with LMA and 13 cases with ETT and in the vaginal delivery group were 13 and 5 cases, respectively. In 42/43 cases the LMA was successfully managed, the other case required ETT. There were better Apgar scores and less need on intensive neonatal care in the LMA group. The resuscitator without randomization decided to use LMA or ETT. These patients were included in two other reports by the same authors (Trevisanuto 2004, Trevisanuto 2005).

**Addendum: Citation List of Case Report**


**Critique:** Level 5, poor; Case Report. Support. Difficult airway. Operating room.

A report on 8 day-old NBT with complete tracheal rings, who was ventilated with a LMA after a failed endotracheal intubation during a surgery for placement of a ventricular-peritoneum shunt.


**Critique:** Level 5, fair, Case report. Support. Difficult airway. Operating room.

Five separated cases on 1-month-old infants with difficult airway (Two with Pierre Robin syndrome and three with Treacher-Collins syndrome) in whom the LMA was used to realize a fiberoptic intubation awake after a failed endotracheal intubation. The insertions were made at the operating room for a planned for the surgical fixation of the tongue for relieves hypoxia. More times case report of difficult airway is successfully treated.


**Critique:** Level 5, fair; Case Report. Support. Resuscitation on delivery room. Difficult airway.

A successful management of difficult airway achieved with a fiberoptic intubation through a LMA was done, for a term fetus with prenatal diagnosis of severe micrognathia on an EXIT procedure, and survival of the newborn.


**Critique:** Level 5, fair; Case report. Support. Resuscitation on delivery room. Drug administration.

This case report describe two newborns, one 30 weeks 1.36 kg premature resuscitated at the delivery room with LMA after face-mask and endotracheal tube failed (there was no explanation on the reason), he was then managed with nasal CPAP for respiratory distress syndrome. Through a LMA two separate times exogenous surfactant was administered. The other newborn was a 37 weeks, 3,200 g infant who developed respiratory distress syndrome and surfactant was administered through a LMA for the only reason of the success of the first case. In both cases no anomalies were described.


**Critique:** Level 5, poor; Case Report. Support. Resuscitation on NICU. Difficult airway. Long-term application.

A report on a 10-day old term infant with Treacher-Collins syndrome and acute airway obstruction relieved with a LMA after face-mask ventilation and endotracheal intubation failed. The LMA was left is situ for 4 days, but another episode of acute airway obstruction occurred, and the parents and personal decide withdraw support. There was not identified the cause of the airway obstruction.

Critique: Level 5, poor; Case report; Operating room; Procedure.
One male infant on first day of life, 33 week gestation, 2050 gram, with congenital complete heart block, a LMA was used during the installation of a permanent pacemaker during general anesthesia without problems, the patient was managed without muscle relaxants and breathed spontaneously.


Presents two newborn with Pierre Robin sequence in which the LMA was used as a conduit to introduce an endotracheal tube. The authors recommend the multiple uses LMA for fiberoptic intubation.


One Premature infant of 35 weeks and 1,560g weight with airway malformation who in his fourth day of life required resuscitation with face-mask ventilation, after a failed intubation a LMA was placed and was maintained for 44 h successfully with conventional mechanical ventilation through the LMA. An ETT was placed through the LMA using a fiberoptic bronchoscope.


In a rural facility without obstetric care, a neonate 36 weeks, 2.3 kg with multiple congenital anomalies, obtained by cesarean section, the neonatal resuscitation was initiated for ineffective breaths, a local pediatrician gave ventilation with face-mask but was ineffective, after a failed endotracheal intubation, outside DR a LMA was inserted and the patient was transfer to a tertiary facility. The pediatrician with minimal experience using LMA was able with verbal instructions to successfully place it.


A 5-day-old term infant, 2.4 kg, with Smith-Lemli-Opitz syndrome, who was intubated by fiberoptic bronchoscope through a LMA after a failed intubation, the patient was on anesthesia with spontaneous ventilation during all the surgery on the gastrointestinal tract.


Critique: Level 5, good; Mechanical Model. Support. Resuscitation.
This comparison between size 1 LMA classic and LMA ProSeal during pressure controlled ventilation in a neonatal intubation manikin. Two physicians with experience in neonatal resuscitation made all the LMA insertions at random way in a neonatal intubation manikin with an introducer provider by the manufacturer. The correct position was confirmed by a fiberscope. A pressure-controlled ventilator provided the ventilation a then applied increasing inspiratory pressures from 10 to 40 cmH2O. The peak and mean pressures between 10 to 22 cmH2O were similar for both instruments, and from 25 to 40 cmH2O were higher with PLMA (P<0.01). The higher oropharyngeal pressures with the PLMA could be more usefully in neonate’s lung disease, but the problem will be usually the size of the LMA and low weight of these patients. Also there is not experience with live neonates needing complex resuscitation.


A case of thoracopagus conjoined twins, at 1.5 months-old requiring general anesthesia for MRI angiography of complex cardiac anatomy in which a LMA was inserted after a failed intubation for difficult airway. The LMA was introduced and maintained for all the procedure (6 hours) successfully by anesthesiologist.

A case on a premature with difficult airway by a subglottic intramural mass in which a LMA was used for a fiberoptic bronchoscopy and a tracheostomy during general anesthesia. The patient was maintaining with spontaneous respiration as with PPI during all the procedures.


Two cases, one term infant 6 days-old with Naggar’s Syndrome, a tracheostomy was planed, but direct laryngoscopy in OR was failed then a LMA was inserted awake. Two endotracheal tubes were attached end-to-end and inserted into the LMA. The other case was and a 26-months-old infant with Treacher-Collins syndrome who needed bronchoscopy and an ETT was inserted into the LMA successfully.


Critique: Level 5, fair; Case report. Support. Resuscitation.
Two cases with the use of LMA. One 2.61 kg, 36 weeks, who shortly after delivery (elective cesarean) develop severe respiratory distress, and after a ineffective face-mask ventilation, failed intubation, chest compression and epinephrine administration had temporary episodes of improvement, a choanal atresia was suspected and ventilation with an oral airway with face-mask was initiated. The transfer team suggest by telephone to the physician insert a LMA. The patient was successfully maintained until an orotracheal the transport team did intubation and the patient was transfer to another hospital. The other patient was a 2.7 kg, 41 weeks with severe micrognatia and glossoptosis delivery by emergency cesarean section. For bradicardia and respiratory distress, after ineffective face-mask ventilation and three failed intents with ETT, a LMA was introduced. The transfer team intended another intubation, as this was not possible, the patient was transfer to another hospital with a LMA and PPV. Another report on cases with difficult airway and successful airway patency with LMA. Only one patient was inter-hospital transfer with LMA


One case of a 2.9 kg, 40 weeks infant with Pierre Robin syndrome who presents progressive respiratory distress, after several intents a blind intubation was done, after five days the respiratory failure recurred after an extubation. After a new failed intubation a LMA was successfully introduced. The LMA was left in place for six days with the patient breathed spontaneously, and was removed each day to relieve pre pressure on the mucosa. The patient was discharged with nasogastric tube breathing spontaneously.