Neonatal Laryngeal Mask Airway (LMA) Insertion - Use of Task Analysis to Inform the Development of a Procedural Checklist

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Abstract

Abstract Body: Effective positive pressure ventilation is the single most important step in neonatal resuscitation. Neonatal Resuscitation Program (NRP) supports the use of the laryngeal mask airway (LMA) as an alternate airway device when endotracheal intubation is technically challenging (e.g. unsuccessful attempts, airway anomalies, or operator inexperience) (1). Practicing neonatologists have limited experience using an LMA. Proficiency is attained only after 5-24 attempts (2-4) - challenging for any practicing neonatologist. Simulation-based training that allows repeated practice and feedback may bridge this gap. Our long term aim is to develop an educational toolkit and checklist for LMA placement. Our specific aim was to perform a task analysis to identify key steps of LMA insertion as an objective method of developing a checklist for teaching and assessing this procedure.

Methods: Literature review revealed one published checklist with insufficient detail to effectively teach LMA insertion (5). A task analysis was performed to objectively detail each step and determine essential actions, optional actions, and decision points. 5 pediatric anesthesiologists (experts) performed LMA insertion on a neonatal task trainer while being videotaped. 5 neonatologists, inexperienced in neonatal LMA insertion, independently reviewed these recordings and the NRP LMA procedural video (1). Independently each developed a script that outlined the steps of LMA insertion which were de-identified and collated. A modified Delphi process was then used to create the checklist. Differences in step sequence and level of detail were resolved by consensus until complete agreement was reached.

Results: Independent review of the videotapes by the 5 neonatologists revealed a median of 16 steps (range 10-20). Step sequence and level of detail varied between neonatologists. Modified Delphi and consensus review revealed 11 main steps, each with a set of associated sub-steps. The main steps include: time out/universal precautions, identification of the indications and contraindications, equipment preparation, patient positioning, patient preparation, correct positioning of the device prior to insertion, insertion, inflation of the cuff, confirmation of device position, securing the device, troubleshooting and resolving complications. Sub-steps ranged from 1-6 for each main step. The final checklist included 16 items.

Conclusion: An LMA insertion checklist was developed using task analysis. Review by inexperienced practicing neonatologists highlighted variation in step sequence, detail level
and the importance of novice review to elucidate implicit aspects of the procedure that experts may not readily verbalize. We recommend performing a detailed task analysis, a method that has been applied to surgical simulation (6), prior to development of procedural checklists. Next steps include cognitive task analysis to determine the most likely technical errors that occur during LMA insertion.

**BACKGROUND**

- Effective positive pressure ventilation is the single most important step in neonatal resuscitation.
- The Neonatal Resuscitation Program (NRP) supports the use of the laryngeal mask airway (LMA) as an alternate airway device when endotracheal intubation is technically challenging (e.g., unsuccessful attempts, airway anomalies, or operator inexperience) (1).
- Practicing neonatologists have limited experience using an LMA, and proficiency is attained after 5-14 attempts (2-8), which is challenging for any practicing neonatologist to attain.
- Simulation-based training that allows repeated practice and feedback may bridge this gap. However, no robust training tools currently exist for performance and assessment of this important procedure.
- Task analysis that objectively outlines procedural steps is a method that has been applied to surgical simulation (9) and performance of other psychomotor skills, prior to development of checklists, assessment tools, and virtual models.

**OBJECTIVE**

- To identify key steps in neonatal LMA insertion using task analysis as an objective method of developing a checklist for teaching and assessing this procedure.

**METHODS**

- Literature review revealed a single published checklist with insufficient detail to effectively teach LMA insertion (10).
- Task analysis:
  - 3 pediatric anesthesiologists (experts) performed LMA insertion on a neonatal task trainer (according to their clinical practice) and verbally described steps of the procedure while their performance was videotaped.
  - 5 neonatologists (inexperienced in LMA insertion) independently reviewed the videotapes, as well as, a commercially available procedural video (10) and developed a script that outlined the steps.
  - A modified Delphi was used to create a checklist based on the developed scripts.
  - Differences in step sequence and level of detail were resolved by consensus until complete agreement was reached.

**RESULTS**

- A median of 16 steps (range 12-20) was required to successfully insert a neonatal LMA.
- Step sequence and number varied between neonatologists.
- LMA insertion was divided into 4 major steps:
  1. Time out/universal precautions
  2. Identification of the indications and contraindications of the procedure
  3. Equipment preparation
  4. Patient positioning
  5. Patient preparation
  6. Correct positioning of the device prior to insertion
  7. Insertion
  8. Cuff inflation
  9. Confirmation of LMA position
  10. Securing the device
  11. Troubleshooting and resolving complications
- Sub-steps ranged from 1-6 for each main step. The final checklist included 16 items.

**CONCLUSION**

- Task analysis of expert performance was used to develop a 16-item LMA insertion checklist.
- Videotape review by practicing neonatologists (inexperienced in LMA insertion) highlighted:
  - Variation in step sequence and number, which supports the importance of task analysis with modified Delphi review to construct a comprehensive procedural checklist.
  - The importance of novice review to elucidate implicit aspects of the procedure that experts may not readily verbalize.