Air Medical Journal 37 (2018) 41–45

Contents lists available at ScienceDirect

Air Medical Journal

journal homepage: http://www.airmedicaljournal.com/

Original Research

Development and Testing of a Neonatal Intubation Checklist for an Air Medical Transport Team

Lisa A. Davidson, DNP, RN, CPNP, CCRN *, Richard B. Utarnachitt, MD, Andrew Mason, RN, Taylor Sawyer, DO, MEd

Airlift Northwest, Department of Pediatrics, Division of Neonatology, Seattle, WA

A B S T R A C T

Objective: We developed a Neonatal Intubation Checklist for Airlift Northwest. Our goal was to improve the preparation, technical proficiency, and safety of neonatal intubation without increasing the time required to perform the procedure.

Methods: The Neonatal Intubation Checklist, a "call and response" checklist for neonatal intubation, was developed. Its effectiveness was evaluated during a baseline assessment and 2 practice sessions after a checklist orientation. Intubation proficiency was evaluated using a validated assessment tool that included a proficiency score, a global rating scale (GRS) score, and time to perform the procedure.

Results: Significant improvements in intubation proficiency and time to intubation were noted when teams used the intubation checklist (proficiency score: 29 [7] at baseline vs. 57 [1] with checklist, $P < .001$; GRS 2 [2, 2.5] at baseline vs. 5 [3, 5] with checklist, $P < .001$; baseline intubation time 626 [93] seconds vs. 479 (44) seconds with checklist, $P < .001$). These changes were associated with a large effect on proficiency ($\eta 2 = 0.89$), GRS ($\eta 2 = 0.6$), and time to successful intubation ($\eta 2 = 0.52$).

Conclusion: The use of the Neonatal Intubation Checklist improved transport team performance during simulated neonatal intubations and decreased the time required to successfully perform the procedure.

Neonatal intubation performed by transport team members in an unstructured transport environment is a low-volume, high-acuity event. Studies exploring neonatal intubation in the hospital and prehospital settings report low first-pass success rates, some as low as 25%.[1-7] First-pass intubation success rates in neonates are lower than rates in pediatric patients, even though neonates are more likely to require intubation in an emergent setting.[8,9] Neonatal anatomy poses unique challenges, with a small mouth opening, an anterior larynx, and sensitivity to hypoxia with very limited functional residual capacity.[10,11] Neonates are prone to adverse events during intubation attempts, particularly bradycardia, desaturation, and improper tube placement.[6-8,12] Each intubation attempt has the potential to cause airway trauma and decrease physiologic stability, making subsequent attempts at intubation more challenging.[10] Urgency creates additional hazards with emergent neonatal intubation, causing increased risk of complications compared with elective intubation.[12]

Failed intubation attempts have been linked to intraventricular hemorrhage and poor neurodevelopmental outcomes in preterm infants.[7,13,14] The process of neonatal intubation requires not only technical skills but also teamwork skills, planning, and equipment essential for patient safety.[15] Transport teams performing neonatal intubation must develop processes to optimize technical proficiency, as well as methods to ensure efficient teamwork during the procedure. Simulations and checklists are ways in which to standardize and practice high-risk, low-volume procedures.

Checklists are used in the health care environment to enhance patient safety and minimize error. The National Audit Project in the United Kingdom highlighted the lack of contingency planning and inadequate preparation as contributors to airway management complications.[16] The World Health Organization Surgical Safety Checklist and Central Line Bundle Checklist are 2 widely adopted tools shown to improve patient safety and patient outcomes.[17,18] Haynes et al[19] adapted recommendations from the World Health Organization Surgical Safety Checklist to create a surgical checklist for a large prospective study; they reported a decrease in surgical complications when their surgical checklist was used. Checklists ensure all essential equipment is available and provide a safety net for providers when cognitive load is high.[20]

* Address for correspondence: *Lisa A. Davidson, DNP, RN, CPNP, CCRN, Airlift Northwest, Department of Pediatrics, Division of Neonatology, Seattle, WA.*

E-mail address: LisaAnn.Davidson@airliftnw.org (L.A. Davidson).

1067-991X/$36.00

https://doi.org/10.1016/j.amj.2017.09.010

Prehospital and emergency department intubation checklists for adult and pediatric intubation also have been developed.[20-22] These checklists organize the high cognitive load required for prehospital intubation in an effort to decrease adverse events such as hypoxia, bradycardia, or insufficient planning at the time of intubation.[21-23] Hatch et al[4] reported a 10% decrease in adverse events when their inpatient neonatal intubation checklist was used.

We examined the impact of the Neonatal Intubation Checklist on our air medical transport teams. The primary goal was to improve their competency and proficiency during neonatal intubation. Our secondary goal was to provide a means of standardizing training for neonatal intubation. We hypothesized that use of the Neonatal Intubation Checklist would improve intubation performance without increasing the time required to complete the procedure.

Methods

The study followed a *time series design. The study intervention was the introduction of the Neonatal Intubation Checklist as a cognitive aid during simulated neonatal intubation scenarios. Outcome measures included* proficiency at neonatal intubation and time to completion. *These outcome measures were assessed at 3 points: 1) a baseline assessment of neonatal intubation performance without the intubation checklist; 2) 1 practice session using the Neonatal Intubation Checklist as a cognitive aid; and 3) a final testing session using the checklist.* Study subjects consisted of transport nurses employed by Airlift Northwest, an independent air medical transport service based in Seattle, WA, that conducts 3,500 flights annually throughout the Northwest United States. Airlift Northwest responds to 130 to 150 neonatal transports annually; of these, approximately 10 require teams to perform neonatal intubation. Transports are staffed by 2 critical care registered nurses (RNs), 1 is a pediatric/neonatal RN and the other one is an adult trained RN. Both are additionally trained in air medical transport. Demographics of the ages and years of experience in air medical transport are shown in Table 1. The study was approved by the Seattle Children's Hospital Institution Review Board.

Neonatal Intubation Proficiency Assessment Tool

To determine the proficiency of transport teams in performing neonatal intubation, we developed a Neonatal Intubation Proficiency Assessment Tool (NIPAT) (Appendix 1). The NIPAT was developed based on published neonatal intubation procedural guides[23] and included all the steps required to safely intubate a neonate. Several check-back and cross-check steps were included as an indicator of teamwork. The NIPAT included 29 individual steps, each graded on a scale of 0 to 2 with 0 being "not done"; 1 being "done partially, done incorrectly, or done by wrong person"; and 2 being "done correctly and by correct person." A score of 2 on each step resulted in a maximum raw numeric score of 58. In addition to scoring the intubation process, the NIPAT also included a 5-point global rating scale (GRS) of overall performance. The NIPAT GRS was graded from 1 (poor) to 5 (excellent). Anchors were included on the GRS to define poor or excellent performance. The NIPAT also included a section to record the time required to complete the procedure. Intubation time was defined as the period from the decision to intubate until the endotracheal tube was successfully placed and secured. The NIPAT was used to evaluate intubation proficiency during the baseline, practice, and testing sessions.

Table 1
Demographics

	Study Subjects (N = 18)
Age, mean (SD)	44.8 (7.7)
Years of experience in air medical transport	11.8 (8.4)

SD = standard deviation.

The NIPAT was validated according to 5 sources of validity described by Downing: content validity, response process, internal structure, relationship to other variables, and consequences.[24] Evidence for content validity included basing the steps of the NIPAT on published procedural skills guides. Response process validity was demonstrated by using a single rater (T.S.) to conduct all the assessments. Internal structure validity was ensured by aligning NIPAT items around the single construct of intubation. Relation to other variables was examined through an analysis of the relationship of NIPAT scores to GRS. Consequence validity refers to the impact on examinees from the assessment score and outcome. This was a low-stakes, formative evaluation. No adverse effects were associated with the assessment.

Baseline Assessment

For the baseline practice and testing sessions, 18 flight nurses were paired, creating 9 two-person teams, modeled after the normal air medical team configuration. During the baseline assessment, teams performed neonatal intubation during a simulation-based scenario according to standard practice, without the Neonatal Intubation Checklist as a cognitive guide. The simulation scenario used in the baseline assessment consisted of a late preterm infant on nasal continuous positive airway pressure (CPAP) who required urgent intubation. Baseline performance was evaluated using the NIPAT.

Practice Session

After completing the baseline assessment, each team was instructed in the use of the Neonatal Intubation Checklist (Appendix 2). The Neonatal Intubation Checklist was developed using a modified Delphi method, wherein a group of 24 subject matter experts provided feedback on the checklist content, structure, and format over a series of 4 focus group meetings. Subject matter experts included experienced flight nurses and a board-certified neonatologist. The checklist included all the critical steps of neonatal intubation, including equipment preparation, medication administration, intubation procedure, endotracheal tube placement check, and securing the endotracheal tube. The Neonatal Intubation Checklist used a call and response system in which 1 team member calls out an item, and the other team member responds with an affirmative or negative. This system ensured all equipment and medication needed for safe intubation were available before initiation of the procedure.

Instruction in the use of the Neonatal Intubation Checklist included reviewing the checklist, with an explanation of each of the sections and steps, and watching a demonstration video. The video showed a team of 2 flight nurses using the Neonatal Intubation Checklist during a mock neonatal intubation scenario. The purpose of the video was to provide a concrete example of how to use the checklist in practice. After the video, a question and answer period followed, during which time any outstanding questions regarding the Neonatal Intubation Checklist and its use were addressed.

After an orientation to the Neonatal Intubation Checklist and the video demonstration, flight nurses were assigned to 2-person teams and then participated in a practice session using the Neonatal Intubation Checklist. The clinical case in the practice session involved a preterm born 34-week neonate with respiratory distress syndrome requiring intubation. During the practice session, teams used the Neonatal Intubation Checklist as a cognitive aid to prepare equipment and perform the procedure. Their proficiency in performing the procedure during the practice session was evaluated with the NIPAT.

Neonatal Intubation Proficiency Testing

After the initial practice sessions were completed, the teams participated in a final testing session to assess their proficiency performing the procedure. The clinical case in the testing session was the same as the scenario in the practice session. During the