RESEARCH BRIEF

Proficiency of Residents and Fellows in Performing Neonatal Intubation

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Objectives: To determine success rate and time taken for intubation by pediatric residents/ fellows. **Methods:** Prospective observational study among neonates requiring endotracheal intubation. **Results:** 212 attempts and 118 successful intubations were recorded in 153 videos. An average of 1.93 attempts per successful intubation was observed. Success rate at first attempt and mean time taken by first year, second year, third year residents and fellows were 26% and 51.9; 79% and 39.8; 69% and 40.1; and 67% and 31.5 seconds, respectively. Complications were noted in 77 (36%) attempts. 44 (21%) intubations were performed within 30 seconds. Increase in complications was noted with increase in attempt time beyond 40 seconds. **Conclusion:** Skill improved from first year to second year. Most intubations exceeded 30 second time limit. There is a need to improve training methodology to ensure intubation time by health personnel does not exceed the expected time limit.

Keywords: *Intubation, Trainees, Training evaluation.*

Intubation is an essential component of neonatal resuscitation at time of birth as well as in the Neonatal Intensive Care Unit (NICU) [1-5]. Skill level of the health care provider in intubation correlates with the patient outcome [6,7]. Studies conducted in other countries show that residents have difficulties in performing neonatal intubation and in leading resuscitation efforts [8-10]. The scenario in India is different, where residents primarily participate in patient care under the guidance of seniors/fellows.

The primary objectives were to determine the success rate and duration of intubation attempts. The secondary objectives were to determine relationship between experience and success rate and intubation time, and to determine the occurrence of immediate complications.

Methods

It was a prospective observational study carried out from March 2011 to October 2012. Study was approved by the Institutional Ethics Committee. Convenience sampling of neonates intubated in the study period, both term and preterm requiring intubation, as identified by the primary caregiver, were included in the study. Neonates with congenital malformations were excluded from the study. Videos were taken in NICU and emergency room by nurses, interns or residents whenever an intubation was performed with the help of mobile phones (Nokia C7, Samsung S Plus, iphone 3gs, Sony Ericsson W8) and digital camera (Canon Ixus 105). Time was assessed from the video itself as most video players give a timeline. Neonates were videotaped for 5 minutes after intubation to note the immediate complications. The providers were trained in accordance to Neonatal Resuscitation Program, American Academy of Pediatrics – 2010. Written informed consent was obtained from parents of neonates for intubation as is hospital policy. Due waiver was obtained from the Institutional ethics committee for videographing the procedure with the understanding that the videos will be available to the authors only. Videos will be deleted after a period of five years from publication of the study. Informed consent was obtained from fellows and residents who were the participants of the study.

Videos were saved and analyzed using VideoLan software to run the videos, and were analyzed by three authors in a group to decrease reviewers' bias. Using predefined checklist and criteria for the procedure, the authors looked at timing of various parts of the process, maintenance of asepsis, etc. Two junior authors analyzed the video on a single proforma, and the senior authors view was taken if there was a disagreement. Videos were analyzed at the end of the study at the convenience of the three authors. Procedural success was defined as the endotracheal tube in the airway beyond both the vocal cords. Anterio-posterior *X*-rays and clinical examination were used to confirm the endotracheal tube position. Duration of each attempt was noted from the time of

introduction of laryngoscope blade into mouth to the time it was removed.

Success rate was determined as the proportion of success in first attempt. Attempts required for single successful intubation was derived as ratio of total number of attempts to successful intubations. Analysis of Variance (ANOVA) with *post hoc* comparison was used to assess association between experience and skill (in terms of mean attempts and mean time).

RESULTS

A total of 153 videos were reviewed, which consisted of 212 attempts and 118 successful intubations. Eleven pediatric residents and 4 neonatal fellows participated in present study.

Eighty nine (88.9%) of the intubations took place in the NICU. Seventy-seven (50.3%) were intubated on day one, 19 (12.4%) were intubated between 1-3 days, 31 (20.3%) were between 3-7 days. Indications for intubation were respiratory distress in 91 (59.5%), accidental extubation in 22 (14.4%), birth asphyxia in 19 (10.9%), meconium aspiration syndrome in 12 (7.8%), neonatal resuscitation in 5 (3.5%), convulsions leading to an unmaintainable airway in 3 (2.0%), and apnea of prematurity in 2 (1.4%) neonates. 77 (50.3%) neonates were full term with mean (SD) birth weight being 1.99 (0.65) Kg.

In 107 (69.9%) videos, intubation was successful in first attempt, while in 36 (23.5%), 8 (5.2%), and 2 (1.4%) videos there were second, third, and fourth attempt, respectively. Overall success rate for first attempt was 60.1% and 1.93 attempts were required for a single successful intubation (***Table* I**). First year residents had lower success rate as compared to fellows, second year residents, and third year residents (all $P < 0.05$). There was no difference between success rates of fellows, third year and second year residents. Overall mean (SD) duration needed for intubation was 42.6 (20) [Range: 7, 122]. Forty-four (20.8%) intubations were performed under 30 seconds. There was significant difference between the mean time required for intubation by fellows [31.55 (12.8)] *vs* first year residents [51.9 (23.2) s, (P<0.001)] and second year [39.38 (17.42)] *vs* first year residents [51.9 (23.2), (P=0.008)]; but no significant difference between third year [40.1 (14.5)] *vs* first year residents [51.9 (23.2) s, (P=0.14)]. No difference existed between the mean time of second year and third year residents and fellows. Complications were noted in 77 (36.3%) of intubation attempts. The complications were associated with the time required for intubation (***Table* II**).

Four residents were longitudinally tracked over the one and-half-year study period. All of them showed significant improvement in their success rate as they moved from first year to second year of residency. No significant difference was seen in transition from second year to third year.

DISCUSSION

The current scenario in India is different from developed countries where restricted duty hours lead to limited NICU exposure and there is an overall decreased need for intubation, due to increased use of non-invasive ventilation and the change in the guidelines for meconium stained liquor [6]. Due to these reasons, pediatric residents in developed countries have been deprived of minimum intubation opportunities needed to master the skill [6,10].

Age of neonates at intubation and common indications were similar to other studies [11,12]. Higher number of attempts by the first- and second-year residents were because they were the first responders. Success rates of intubation in the present study was slightly higher and attempts required to perform a single successful intubation were slightly less than other studies [6,9,13,14].

There was significant improvement in the intubation skill of a second year resident compared to a first year resident. This is unlike other recent studies wherein no significant improvement in intubation skill occurred during residency [8,9,15]. However, there was no significant improvement in success rates of second year residents, third year residents, and fellows. It may be

TABLE I PERFORMANCE OF VARIOUS GROUPS

Group	*No. of videos, n (%)*	*Attempts required**	*Success rate# (95% CI)*	*P value*
I y residents	53 (34.6%)	3.6	26.4(15.3, 39.0)	–
II y residents	57 (37.3%)	1.2	78.9(66.1, 88.4)	<0.001
III y residents	19 (12.4%)	1.4	68.4(43.4, 86.7)	0.003
Fellows	24 (15.7%)	1.5	66.7(44.7, 83.6)	0.001

** for successful intubation; # of first attempt.*

TABLE II TIME NEEDED FOR INTUBATION AND COMPLICATIONS

N	*Time required n (%)*		
	<30s (n=44)	*30-40s (n=37)*	*>40s (n=72)*
Hypoxia	14 (31.8)	14 (37.3)	49 (68.1)*
Bradycardia	5 (11.4)	2 (5.4)	6 (8.3)
Esophageal intubation	2 (4.5)	5 (13.5)	0
Trauma	1 (2.3)	0	1 (1.4)

**P <0.001 as compared to <30s.*

WHAT THIS STUDY ADDS?

- There was an improvement in intubation skills from first year to second year of residency but not after that.
- No increase in complications was seen if duration of intubation attempt was increased from 30 to 40 s.

ascribed to the fact that the third year residents and fellows reached a ceiling because of fewer intubation opportunities and duty hours as compared to second year residents. Another factor that may be considered, but was not recorded in our study, is the fact that in majority of the circumstances third year/fellows intubated patients with expectant difficult intubation or patients in whom the junior residents had failed.

No group had a mean duration of intubation attempt within the recommended 30 second limit required by NRP 2010, with only 20.8% intubations occurring within 30 seconds. Other studies have shown similar results [10]. Complications of intubation were comparable to other studies [13,15]. In spite of the higher mean time required for intubation, the complication rate remained the same. There was an increase in occurrence of hypoxia as the attempt time exceeded 40 seconds. The study design does not allow us to draw a definite conclusion but the current study supports a consideration for an extension of the 30 second limit of intubation up to another 10 seconds.

The strengths of the study were that, it was conducted by video recording the intubations to eliminate the observer bias and analysis of the videos was done by all of the authors in a group to decrease reviewers bias. The limitations of the study were that, it was conducted at a single center, no neonatal consultant participated in the present study, and some neonates could not be videotaped due to shortage of personnel, and data regarding these exclusions is not available. These exclusions have the capability of influencing the results of the study, thereby limiting the generalizability of the study. Other limitations were that stopwatch was not utilized for timing the intubation attempts, but the authors believe that the time line built within the video-player is an accurate tool. End-tidal carbon dioxide estimations, which are considered the gold standard for confirming endotracheal intubation, could not be used in the present study.

In conclusion, the success rate and number of attempts needed for single successful intubation was similar to previous studies. There was significant improvement in the skill of intubation of pediatric residents as their experience increases, but this reaches a ceiling. Consideration to increase the 30 seconds time limit to 40 seconds for intubation should be entertained if the lack of complications with the longer intubation time noted in this study is confirmed in larger studies.

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