

## Neonatal Intubation: Historical View and Future Prospective

**Mahmoud Ali Mohamed Ali\***

*Neonatal-Perinatal Medicine Fellow, Baylor Scott and White Medical Center, McLane Children's Hospital, Temple, Texas, USA*

**\*Corresponding Author:** Mahmoud Ali Mohamed Ali, Neonatal-Perinatal Medicine Fellow, Baylor Scott and White Medical Center, McLane Children's Hospital, Temple, Texas, USA.

**Received:** September 04, 2020; **Published:** September 19, 2020

### Abstract

Being less than five decades old, the neonatal medicine is a relatively new subspecialty, however, the neonatal endotracheal intubation which is the cornerstone of neonatal resuscitation and the neonatologists worldwide almost daily practice is not. The neonatal intubation procedures were started two centuries ago, the procedure had a significant improvement in term of the instruments used, the technique, and how to make it safer to avoid the tracheal intubation associated adverse events. Advancements in neonatal intubation was linked with subsequent improvement of the endotracheal tubes as deemed necessary. The accountability for newborn tracheal intubation had changed overtime from obstetricians and midwives to the anesthesiologists and eventually to the highly skillful pediatricians and neonatologists who spend years of clinical training before mastering the procedure. National and international professional association of pediatricians and neonatologists like the American Academy of Pediatrics, the Canadian Pediatric Society, and the National Emergency Airway Registry for Neonates have announced multiple evidence-based recommendations to optimize the intubation environment. Video laryngoscope usage for neonatal intubation was a breakthrough technology which helped a lot to perform difficult intubation encounters, it is used in more centers now worldwide and is expected to be easily accessible all over the globe soon. Other technological jumps in this field are the apneic oxygenation and 3-dimensional computed tomography airway assessment which will take the neonatal tracheal intubation to the next step. Because the incidence of neonatal intubation has decreased overtime and it will continue to decrease in the future, based on historical trends, Neonatal Resuscitation Program updates, increased use of noninvasive respiratory support and laryngeal mask airways in the delivery room, and the aerosolized surfactant administration, there are increasing concerns that the new generation of pediatricians are not getting enough exposure to neonatal tracheal intubation, herein come the role of novel technology which will make less expertise more comfortable at the intubation encounter, however the novel advances will not eliminate the need to intubate a newborn, endotracheal intubation using direct laryngoscope will remain an essential skill for clinicians especially in resources limited countries and in emergency situation when technology fails, clinical training will remain indispensable.

**Keywords:** *Clinical Training; Neonatal Intubation; Neonatologists*

### Introduction

Neonatal intubation is a fundamental skill in neonatal medicine since the establishment of the subspecialty five decades ago; however, the earliest neonatal intubation thoughts started at the seventeenth century [1-4]. Nowadays clinicians are more comfortable doing the

procedure although the incidence of neonatal intubation has decreased over time [20,29]. Fiberoptic laryngoscope is one and not the only vivid example for the technology-assisted neonatal intubation [44].

### Historical Background

Benjamin Pugh, an English obstetrician, used a small tube made of coiled wire and covered in leather to ventilate the lungs of asphyxiated newborns in 1754, this was the earliest thoughts for neonatal endotracheal intubations utilized for resuscitation [2,4], another obstetrician, Paul Scheel, described the first detailed neonatal tracheal intubation in 1798 [7,8]. Since that time, steady renovation of the procedure has been taking place. Initially, physicians and midwives in training used their fingers to guide the tube into the larynx [7,8]. Indirect visualization of the larynx was not possible till the 1800s [5,6], digital intubation continued to be widely practiced through the mid-1900s [10]. Using direct laryngoscopy to intubate the trachea with a high success rate was reported for the first time in 1913 [9], after that, especially with the development of a laryngoscope specifically designed for neonatal intubation in 1928 [14], the direct laryngoscopy rapidly made the neonatal intubation achievable worldwide, and a cornerstone in neonatal resuscitation [4,12,13,14]. Obviously, the laryngoscope sustained a treasured improvements overtime in battery technology, light source as well as the overall design. The universal recognition of neonatal laryngoscopy was followed by improvements in the endotracheal tubes, these improvements included changes in tube shape, size, and manufacturing materials, which made the endotracheal tubes safer and better tolerated by airway tissue [3,15,16].

The accountability for newborn resuscitation had changed overtime. Historically, the obstetricians [or the midwives] used to take care of newborns during the first weeks after birth [15], anesthesiologists were routinely intubating newborns by the mid-1900s [17]. In the 1950s, pediatricians began taking responsibility for newborn resuscitation [18], then specialists in neonatal care took this call [15]. Currently, neonatal intubation is a crucial skill for pediatricians and neonatologists, they are required to attend high risk deliveries where most of the emergency intubations take place [38,39]. Thus, pediatric residents and of course fellows are required to demonstrate competency in this fundamental procedure, a practice that continues to this day [19].

The direct laryngoscope stands as the most used instrument for neonatal endotracheal intubation today [21]. The design of the neonatal laryngoscope has changed overtime; however, the evolution of video laryngoscopy is the most technologically advanced aid in neonatal intubation [22]. A video laryngoscope differs from traditional laryngoscope basically in the small camera built in with the blade, allowing the airway view onto a video monitor, this provides better visualization of the airway [22]. video laryngoscopy usage for neonatal intubation increases first intubation attempt success rate [23-26]. In limited-resources environment, many clinicians around the world still practice digital intubation [27]. In experienced hands, digital intubation can be as successful as direct laryngoscopic intubation and it could be performed even faster [28].

### Safety issues

The number of intubation procedures have decreased over the last two decades due to advances in perinatal care, increase in the delivery room usage of noninvasive positive pressure ventilation, and the neonatal resuscitation program changes in suctioning meconium from the airway at birth [29-32]. The number of intubations needed to obtain competency in neonatal intubations is unknown. Buis., *et al.* reported [43] in a systematic review of health care providers learning endotracheal intubation, approximately 50 experiences were needed to reach competency. Studies have found that anesthesia practitioners need between 57 and 75 intubations to achieve a 90% first-pass success rate. [33,34]. A 2015 commentary in Pediatrics, raised concerns that neonatal intubation competency is not achievable for pediatric residents in the United States because of the lack of clinical exposure [35].

Recent efforts have focused on improving the safety of neonatal intubation. Failed intubations are associated with adverse neurologic outcomes in preterm infants [38-40]. The American Academy of Pediatrics and the Canadian Pediatric Society recommends to premedicate all infants before elective intubation to decrease the associated physiological responses [36,37]. In 2014, the National Emergency

Airway Registry for Neonates (NEAR4NEOS) was established, it is a multicenter, international registry, which provides a tool for hospitals for surveillance of their neonatal intubation success rates and adverse events, and to identify best practices, aiming to improve intubation safety [41]. Studies have shown that ; sedation, painkillers, neuromuscular blocking agents, and anticholinergics before neonatal elective intubation reduces the tracheal intubation-associated adverse events, decreases the time needed for the procedure and increases the rate of successful intubation at the first attempt [11,36,42].

### Future expectations

The future of neonatal intubation will likely involve widespread use of video laryngoscopy-assisted intubation and improvements in imaging technology of video laryngoscopy cameras, blade design and size [47]. Smaller devices and making flexible video laryngoscopy more accessible to neonatologists will improve the future of neonatal intubation especially in patients with upper airways abnormalities [48]. 3-dimensional computed tomography (3D-CT) provides a noninvasive alternative to endoscopic assessment of difficult airways especially those with craniofacial anomalies [49]. 3D-CT. anatomic assessment of the airway will also likely improve in the future for virtual planning of airway management [49]. Another novel technique is the apneic oxygenation where the intubators use continuous positive pressure nasal prong or nasal cannula to provide supplemental oxygen to help maintain oxygen saturation during intubation [51], it has been used successfully in adults [52], and it will be a valuable method to optimize the intubation environment for a newborn [21,45].

Although the incidence of neonatal intubation will continue to decrease in the future, based on historical trends, increased use of non-invasive respiratory support and laryngeal mask airways, and the aerosolized surfactant administration [53], the novel advances will not eliminate the need to intubate a newborn. Thus, neonatal intubation will remain an essential skill for clinicians and clinical training will remain indispensable [54].

### Conclusion

Neonatal intubation is an old, persistently required lifesaving skill. Continuous effort to make neonatal intubation safer are critical to improve neonatal outcomes. Intubation techniques and tools have undergone grand improvement over time and will continue to evolve in the future. Currently, video laryngoscopy is a major player in the field, widely available and easy to master. Future technological improvements will help clinician, especially with the decreased number of intubation procedures and the expectation that the available opportunities will continue to decrease. However, Neonatal intubation will remain an irreplaceable skill.

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**Volume 9 Issue 10 October 2020**

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