Blind nasal intubation in a ‘breathing’ manikin- An idea

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Abstract

Blind nasal intubation (BNI) has been around for over a century now. Many clinicians advocate it as an “old-is-gold” skill, which can be performed without any adjuncts in cases where visualization of larynx is a problem. Even today, BNI not only comes handy in resource-limited centers, it may also come to the rescue of airway managers in well-equipped centers. However, in the century since it was first described, there have been other major developments in the field of airway management and BNI as a skill has taken a backseat when it comes to a priority order. More so because it is limited by modalities to teach and train as most of the available manikins, which are otherwise phenomenal when it comes to imitating anatomy and overall attention to detail of a human airway, suffer terribly in one basic aspect needed to teach, train, and learn BNI—“they” cannot breathe! Attempts have been made to fabricate some manikins on these lines. But what if they can not only breathe but breathe out CO₂ as well! We describe a simple method whereby we created a “CO₂ breathing” manikin and tested it in an Airway Management Workshop with 105 participants, and then evaluated it under controlled conditions in 20 volunteers. We got very encouraging results and realized that our manikin makes the teaching and training of BNI very interesting and attractive by simulating the actual clinical scenario. We feel that it has the potential of reinventing the valuable skill of BNI.

Keywords: Blind nasal intubation, breathing, capnogram, HME filter, manikin

Background

Fritz Kuhn had used the method of blind nasal intubation (BNI) as early as 1902,¹ but the present method was discovered by Sir I. W. Magill and E. S. Rowbotham in 1917-21.²³ It became very popular in the following years and was widely used during the First World War, but its use has since declined because it is a blind procedure that needs more time than the better alternatives that came on the scene like flexible fiberscope guided techniques. All this led to the lack of appropriately skilled and trained personnel bringing it further down in the preference order.

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Moreover, investigators have modified the original BNI that “went by the ear” by adding features that make BNI “less blind”. Cuff inflation, lighted stylets, Beck Airflow Airway Monitor (BAAM) whistle, endotrach tubes and whistle combination and EtCO$_2$ monitoring are some such additions.[5-12]

Lately, investigators have created breathing manikins[13] with[7] or without a whistle that promise to take care of the original and other breath sound based approaches. However, the addition of CO$_2$ to these “breathing” manikins is still a problem. We describe here a very simple method to solve this problem that we have tested in the actual training sessions.

The Making of CO$_2$-Breathing Manikin

We used the Laerdal Airway Management Trainer (Laerdal® Medical, India) for this. We disconnected the mainstem bronchus tube from one of the lungs of the manikin and connected a corrugated tube to lengthen it [Figure 1-3]. A sterile gauze piece was put on the open end of the corrugated tube and an operator now put his mouth over the sterile gauze and exhaled into it while inhaling through his nose (the extension tubing allowed the operator to do this standing upright, without having to bend to reach it). This not only created breath sounds like those during spontaneous expiration that were conducted through the endotracheal tube advanced through the nose but also produced normal-looking capnogram once an ETCO$_2$ connector was placed over universal ETT connector [Figure 4].

Few things still needed to be addressed. One, the operator breathing through the manikin did not feel comfortable breathing in from the manikin. Two, the ETCO$_2$ curve did not return to the baseline as quickly as it normally does because

Figure 1: The making of CO2-Breathing manikin-Step 1: One of the lungs (A) (left one in this case) of a Laerdal airway management trainer (Laerdal Medical, India) is detached from its socket in the manikin

Figure 2: The making of CO2-Breathing manikin-Step 2: The tubing of this detached lung, representing its main bronchus (i.e., left in this case) (B) is separated from the lung (A), which is kept aside

Figure 3: The making of CO2-Breathing manikin-Step 3: This tubing representing the main bronchus (B) is lengthened by attaching a corrugated tube (C) to it

Figure 4: The making of CO2-Breathing manikin-Step 4: The volunteer (D) covers the opening of this extension tubing (C) with a sterile gauze piece (E). He now breathes out into the tubing (C) without having to bend down (he breathes in through his nose). Meanwhile the operator (F) at the head-end directs a nasotracheal tube with EtCO2 connector (G) on it. The operator aligns the tube with the laryngeal inlet by listening for the breath sounds and also observing the capnogram (H)
the operator breathing into the manikin only exhaled into it and inhaled through her/his nose. And three, there was chance of soiling of the manikin by the exhaled breath and moisture. These problems were solved by adding an HME filter to the end of the corrugated tube through which the operator breathed into the manikin. HME allowed the operator to breathe in and out through the manikin, trapped most of the moisture and facilitated the capnograph curve become near normal [Figure 5,6].

**Outcome**

The efficacy of this modified manikin was tested at an airway workshop during the Airway Congress Airway-2020 conducted by the Airway Management Foundation™. The nasal intubation workstation was one of the four workstations of Advanced Specialty Workshop on “Airway Skills Unique to Oral & Maxillo-facial Surgery”. The workshop had a brief common presentation on the learning objectives of each workstation. Thereafter, the technique of direct laryngoscope/videolaryngoscope-guided and breathsound-capnography-assisted BNI using our modified manikin was demonstrated on the workstation to small groups of 5-6 participants at one time with necessary instructions. This was followed by a hands-on practical session on the manikin.

The workshop had a total of 105 participants consisting of anesthesia and intensive care junior and senior residents, practicing anesthesiologists and faculty from various teaching institutions. A volunteer breathed in and out of the manikin through a dedicated HME during the actual process of BNI demonstration and practice. All the participants were able to easily practice BNI. All the participants agreed that the addition of capnography reduced their dependence on the quality of breath sounds.

Later we repeated the testing of our manikin with 20 new volunteers in our institution. The participants rated the following: (a) Ease to appreciate the breath sounds—Very easy/Easy/Difficult (b) Improvement in the ease of navigation by the addition of capnography—Remarkable/Little/None. The volunteer breathing in and out of the manikin also rated her/his experience through this questionnaire: (a) Any apprehension of getting ―infected‖ in the process of breathing through the manikin?—Yes/No/Can’t say (b) Will she/he like to perform this job after someone else has done it just before her/him using another HME?—Yes/No/Can’t say (c) How often will she/he recommend that the manikin be cleaned and disinfected—After every volunteer/At the end of one session of workstation/At the completion of one-day workshop.

All the participants found it very easy to appreciate the breath sounds and commented that the addition of capnography remarkably improved their navigation. None of the volunteers breathing into the manikin felt apprehensive about getting infected and every volunteer was ready to perform her/his job soon after any other “healthy” volunteer, provided everyone used a new HME filter. All of them felt that if HME was being used as mentioned, it would be enough to clean and disinfect the manikin at the end of the day.

**Discussion**

BNI is a fading skill because of easy availability of flexible fiberscope for guiding ETT through nose, and of trainers and manikins for the same. BNI may still be worth learning but the non-availability of appropriate manikins and thus trained instructors makes this difficult to learn and teach. The knowledge of this skill, nevertheless, has proven to be of substantial value when other means of securing an endotracheal tube have failed, or are inaccessible even in well-equipped centers.[11]
Various maneuvers and devices have been tried and described to facilitate BNI previously. Listening to breath sounds by operator’s ear was one of the first maneuvers to be described. Later devices have been created to facilitate appreciation of breath sounds; like ETT stethoscopes, and ETT whistles and Beck Airflow Airway Monitor (BAAM) whistle. The other maneuvers that have been used to facilitate laryngoscopy assisted and BNI have been the ETT rotation, patient neck flexion, extension and rotation, and cuff inflation.

Other adjuvants used to guide a blindly introduced NTT (Nasotracheal tube) have been lighted stylets and capnography. Then there have been combination of various devices and maneuvers-like capnography supplemented with an ETT stethoscope using a modified ETT connector.[12]

The challenge to create a manikin to allow transfer of all these BNI-related skills still remained a challenge. March et al. described the idea of a breathing manikin for training of EMS professionals using a resuscitation bag.[13] The advent of BAAM whistle allowed the trainees to direct the ETT based on the intensity of the whistle when they were “in-line” with the airway.

Mimicking spontaneous respiration in a manikin is a practical problem and bimanual compression of the manikin’s lungs with a whistle attached to the end of the tube kind of solved it. But we devised a novel way of doing it just like in a real case scenario. Our modification created a manikin that not only “breathes” like a spontaneously breathing patient, it also breathes out CO₂ to produce a normal capnogram. All other sound enhancing modifications can be added to our model and the maneuvers like tube and neck manipulations and cuff inflation can also be practiced along with it.

As mentioned above, a HME filter can be used to prevent the “airway” soiling and ensure sterility, and allow the volunteer to breathe in and out through the manikin thereby producing a very good EtCO₂ curve. We suggest changing the HME filter for every “volunteer” or “breather” when not using a single volunteer to prevent cross-infection. A one-way valve, if available, can also be used so that the “breather” only exhales into the manikin and inhales room air through his nose. This, however, limits the shape of the capnograph as it may not touch the baseline but the values are still incremental with an obvious waveform that can serve as a good enough guide to direct the NTT. After the workshop, the manikin should be cleaned and sanitized as per the instruction manual of the Laerdal Airway Management Trainer.[14]

Our modification is minimalistic, inexpensive, and easy to install. The only requirements being an airway manikin, a capnograph and a disposable corrugated tube with HME filter. This model provides for a close simulation to a spontaneously breathing patient and enables the practitioner to master a basic and invaluable life-saving skill which might lead to better patient outcomes in grim circumstances. Since the patient selection for such a procedure in elective training is limited, manikin training forms the backbone of teaching practice and our model closely simulates a real patient profile. We also feel that similar system can be created using any other manikin that has a fully closed oro-pharyngeal region (unlike Ambu Airway Management Trainer – Ambu®, Denmark, that has open oropharyngeal portion) and that allows nasotracheal intubation and access to the trachea or bronchus from below (e.g., AirSim Advance series – TruCorp, Ireland).

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Conflicts of interest
There are no conflicts of interest.

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PROFORMA-1

For the operator:

(a) Ease to appreciate the breath sounds – Very Easy Easy Difficult

(b) Improvement in the ease of navigation by the addition of capnography –

PROFORMA-2

For the volunteer giving breaths:

(a) Any apprehension of getting “infected” in the process of breathing through the manikin? -

(b) Will she/he like to perform this job after someone else has done it just before her/him? –

(c) How often will she/he recommend that the manikin be cleaned and disinfected –

After every volunteer
At the end of one session of workstation
At the completion of one complete workshop.