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Simulation and Acquisition of Endotracheal Intubation Skills by Medical Students—A Pilot Study

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Abstract

Introduction: Endotracheal intubation is a vital life-saving skill required by physicians in life-threatening situations in and out of the hospital. Medical students are exposed to these procedures mainly as they rotate through the department of Anaesthesia, in their subspecialty posting in Surgery. In this study, we sought to assess the ease of learning endotracheal intubation by medical students in the skills laboratory using an adult-sized (Laerdal Medical) manikin. **Methods:** This was a prospective descriptive study assessing the ability of medical students at endotracheal intubation during their 12-week rotation in the Anaesthesia Department during their subspecialty posting from August to October 2019 in the Skills Laboratory. An adult-sized manikin (Laerdal Medical) intubating head was used for the study. This was preceded by a detailed lecture and demonstration in the skills laboratory after successful passage of the endotracheal tube and connected to a self-inflating ventilation (Ambou) bag. Adequate chest movement meant proper placement, while the fullness of the stomach meant oesophageal intubation. **Results:** All the 500 level (45) students in the class were recruited for this prospective study. 30 (66%) had successful endotracheal intubation at the first attempt, 7 (14.4%) at the second attempt, 5 (11.1%) at the third attempt, 2 (4.4%) students at the fourth attempt and 1 (2.2%) had successful endotracheal intubation at the fifth attempt. Attempts were made to reinforce information on the practical procedure by a repeat performance by the instructor after each set of successful attempts was separated from the pack of unsuccessful candidates. In the end, however, we had 100% successful endotracheal intubation, but after 5 attempts by the last medical student. **Conclusion:** Endotracheal intubation skills can be learned with some level of ease when done after detailed information and training of medical students. More so when not under undue stress and life-threatening situations in the skills laboratory.

By extension, this increases the confidence of medical students in the live patients in the Operating Theatre, after repeated attempts in the skills laboratory. This has the benefit of improving the chances of acquisition of endotracheal intubation in real-life situations.

Keywords

Endotracheal Intubation, Medical Students, Manikin, Skills Laboratory

1. Introduction

The basic skills of mask ventilation and endotracheal intubation have life-saving implications in emergency settings or operating rooms [1] [2]. In this study, we set out to assess the endotracheal intubation skills of 500-level medical students at the end of a twelve-week posting in Anaesthesiology. There are different ways of teaching endotracheal intubation to students. These include classroom teaching, use of cadavers, live patients, and manikins. The manikin is made with features that make it akin to that of a live patient. Similar studies have been done in other centres in Europe, Asia, and US [3] [4], but none have been done in Nigeria and sub-Saharan Africa. Due to limited learning opportunities for learning endotracheal intubation in the Operating Theatre, the use of manikin is a useful learning model for acquiring this life-saving skill [5] [6]. The places where this skill is useful include the operating room, accident and emergency room, neonatal intensive care unit, children emergency room, and adult intensive care Unit.

The essence of the study is to find out the ease of exposing medical students to endotracheal intubation outside the operating room; and how the early acquisition of endotracheal intubation skills may enhance patient safety and resuscitation in later years in their practice, especially where airway experts are not within reach.

2. Method

This is a prospective descriptive study to assess the ease of endotracheal intubation in a set of medical students in the year 2019. Ethical approval was given by the institutional ethics committee. A group of 500 Level medical students were given a brief lecture on the techniques of endotracheal intubation. Subsequently, they had a practical session using adult manikin in a skills laboratory in the hospital. They were taken through the practice in groups by the lecturers demonstrating the maneuvers using a Macintosh blade laryngoscope and a size 5 curved blade mounted on the handle. The selection was mainly, all students rotating through the department at the point at 500 level of their medical undergraduate training (total number 45). Students not in that group and level were excluded.

Manikins are good for hands-on practice. The students were taught to mount the blade on the laryngoscope handle, open the mouth, insert the laryngoscope blade, using it to move the tongue to the side. With the tip of the blade in the

vallecula, they were taught how to do the upward stroke to expose the vocal cord using the wrist as the fulcrum. At the exposure of the cords, an appropriate size 7.5 ID endotracheal tube (stillet mounted) was passed. Before this, they were taught to ensure adequate neck flexion on the trunk and head extension at the atlanto-occipital joint. After the successful passage of the endotracheal tube a self-inflating (Ambou) bag was used to ventilate. Adequate chest movement and good air entry at auscultation meant proper placement: while filling of the stomach meant oesophageal intubation. Unilateral chest movement and unliteral air entry at auscultation meant one lung intubation which was also an undesirable outcome for the procedure.

At the same time, students were taught to avoid any compression of the teeth or soft tissues (lips) with the laryngoscope blade. Each student took his or her turn. Those who were successful at the first attempt were excluded from subsequent runs. At the intervals between each run, the procedure was explained and demonstrated again by the lecturer. This cycle was repeated until the last student was successful at endotracheal intubation.

Intubation was restricted to a maximum of 2 minutes for each student.

The students were scored as either successful or unsuccessful on or before 2 minutes of the trial. The number of Attempts before successful endotracheal intubation was also noted.

3. Results

45 students were recruited into this prospective cohort study. These were the total number of students in the same class. After simple statistical analysis, 30 students had successful endotracheal intubation at the first attempt, seven at the second attempt, five at the third attempt, 2 students at the fourth attempt and one student had successful endotracheal intubation at the fifth attempt (Table 1 and Figure 1). Attempts were made to reinforce information on the practical procedure by a repeat performance by the instructor after each set of successful attempts are separated from the pack. The successful first attempt was 66.6%. 0f the student population 14.4% was at the second attempt and 11.1% at the third attempt. The fourth and fifth attempts constituted 6% and 3% respectively (Chart 1). In the end, however, we had 100% successful endotracheal intubation, but after 5 attempts by the last medical student.

Table 1. Number of attempts by medical students before successful intubation and percentages.

No of Attempts	Frequency (No. of Students)	Percentage
1	30	66.7%
2	7	15.6%
3	5	11.1%
4	2	4.4%
5	1	2.2%

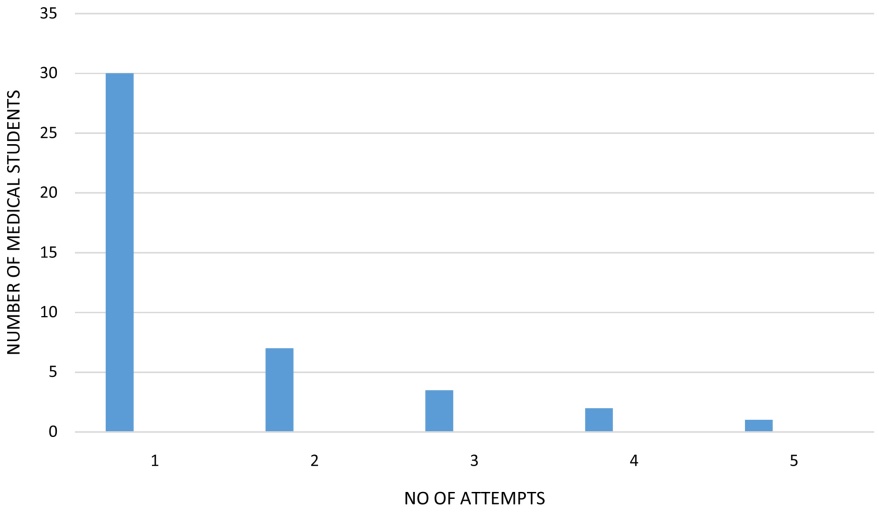

Figure 1. Successful attempts by medical students at endotracheal intubation.

4. Discussion

In this study, we used manikins for safety reasons and ease of learning. Learning endotracheal intubation in live patients is associated with risks to life, especially in unskilled hands, and may require obtaining patient consent for the procedure to be done. Thirty (66.7%) out of the forty-five medical students enrolled in this study had successful endotracheal intubation at the first attempt (**Table 1**). Close values were obtained by studies in other centres among medical students [7]. They suggested that achieving a success rate greater than 90%, required multiple intubation rates greater the 27 attempts. From a similar study in Germany among paramedics, successful intubation rates were 46.4%. In the United States of America, the same studies among paramedics showed a success rate of 99%, while in Israel, it was 78%, revealing variable results in Manikin studies. Warner *et al.* in a study of 56 paramedics had a first attempt success of 66%, a value close to what we obtained in this study. The success rate was affected by situations such as the educational level of the paramedic and skill in rapid sequential intubation applications [7] [8] [9]. In our study, the overall success rate was 100%, though after as many as five attempts by the last student (**Table 1** and **Figure 1**). This value was possible because of the repeated demonstration by the lecturer reinforcing the learning process in the students.

The high level of success at the first attempt (chart 1) suggests a good understanding of the procedure. It also suggests that skills for endotracheal intubation can be acquired easily by medical students who may require these skills in life threatening scenarios. In some countries like South Africa internship period is 2 years, of which house officers rotate through the Anaesthesia and Intensive Care Unit (ICU) [10]. They are required to perform a certain number of endotracheal intubation and acquire the skill of using airway devices during their stay in the specialty. The subsequent drop in the proficiency of the medical students from 14% to 11%, 6% and 3% is suggestive of the need for reinforcement of know-

ledge and skill development. The use of manikin in the skills laboratory provided the required safety and time for repeated trials required for skills development. This has to do with inherent capabilities as the learning curve of each student and duration of exposure (*i.e.*, 2 weeks) of subspecialty posting in Anaesthesia in our institution [11].

The confidence levels are also boosted since the students are not under pressure from the instructor because of the safety of patients when these procedures are done in live patients, though the features of the manikin are close to that of the live patient. These have been proven from previous studies that demonstrate the advantage of improved learning when manikin simulators are used in teaching the art of endotracheal intubation [12] [13] [14].

As close as the learning of endotracheal intubation may be to the use of manikins, it has some obvious limitations when compared with the live situation. In the operating room, laryngoscopy and intubation must be appropriately timed to when there is optimal patient relaxation and sedation. This was what informed our limitation of intubation attempts within 2 minutes, though this may not apply in patients with cardiac arrest. For safety considerations also, limited attempts at endotracheal intubation are allowed. Patient variability is a factor for consideration as Mallam Pati's assessments differ with live patients. Comac and Lehane views of laryngoscopy would also be different as we may have some patients with difficult airway [15]. Also, in live patients, adverse events like airway obstruction, vomiting and haemorrhage may occur.

There is a need to conduct studies with live patients for the students to differentiate live situations from the manikin in our environment. This would further boost their confidence in the acquisition of this skill which would come in handy when such life-threatening situations present in the accident and emergency, prehospital and other places outside the Operating room. Besides, this skill can be lost easily when not put into use, especially when they are only simulation based. Endotracheal intubation remains the gold standard, despite the fact that it is less successful than other airway management modalities in patients with cardiac arrest in the hands of the unskilled. Patient survival is usually better with endotracheal intubation than with other supraglotic tools like the laryngeal mask airway, which are easier to pass for the non-anaesthetist [7].

Use of other tools like the Miller's laryngoscope and supraglotic airway devices are also essential as airway protection is a skill that involves so many complimentary tools that add up to provide overall safety in these scenarios of a compromised airway [16]-[23].

These basic instructions are emphasized in the overall interest of the patients who may need the prompt and efficient intervention of the health care worker or attending physician.

5. Conclusion

Endotracheal intubation skills can be learned with some level of ease after de-

tailed information and training to medical students, especially when not under undue stress and life-threatening situations in the skills laboratory. By extension, this increases the confidence of medical students in the living patient after repeated attempts in the skills laboratory. This has the benefit of improving the chances of acquisition of endotracheal intubation in real-life situations.

Consent

Informed consent received from all medical students involved in the Study.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Abbreviations

ID- Internal Diameter.

OR- Operating Room.

ICU- Intensive Care Unit.