

“Simulation Training – A Paradigm Shift in Gaining Fine Skills and Efficiency to Manage Airway Related Emergencies in ENT”

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Abstract

Introduction: “Simulation” stands for creating a model of a real activity solely for the purpose of training and better understanding. Simulation training can be of several forms live, virtual reality or even computer based, it provides an objective assessment and even helps establish more accurate metrics, making it is a sophisticated and reliable tool.

Aim -The aim of this study was to assess the usefulness and the applicability of simulation training in developing skills needed for airway management such as endotracheal intubation and tracheostomy among junior residents of Otorhinolaryngology and head and neck surgery.

Materials and methodology- Across-sectional observational study done from August 2021 to September 2021 among 27 junior residents, at the clinical skill lab using simulation and the skills of tracheostomy and endotracheal intubation were taught following which OSATS was used in their assessment. Paired T-test and simple percentages were used to access the data which was then expressed in the form of graphs.

Results- The percentage increase in confidence in performing the given emergency procedures as well as knowledge with regards to the same has been shown to increase, significantly with a $p < 0.001$

Conclusion - The use of simulation training, the learners benefit with an intensive training in a low-risk setup with improvement in the skill development, confidence of performing the procedure, technical knowledge regarding airway management with respect to different scenarios. It also enhances the perspective of the learner and urges one to attempt more as the setting is conducive for repetitive training.

Keywords- Simulation training; airway emergency; tracheostomy; endotracheal intubation; emergency in otorhinolaryngology; OSATS; Low fidelity simulation; Medical education; Modern education techniques; Emergency Skill learning

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I. Introduction

Otorhinolaryngology and head and neck surgery is an essential component of primary health care.¹ Due to the large number of medical students at each teaching institute it has become further difficult for all to gather these skills within a short duration^{1,2}. In order to overcome this challenge, surgical specialities such as ours have begun to use simulation training, for development of fine surgical skills and for emergency procedures².

“Simulation” stands for creating a model of a real activity solely for the purpose of training and better understanding.^{2,3} Simulation training can be of several forms live, virtual reality or even computer based, or all the three can be combined to provide us with various angles to approach a specific challenge or procedure. When a particular situation is simulated and observed, slowly and repeatedly researchers will be able to learn more, without the risk of harm to an individual and without any time restriction.³ Team performances and organizational efforts and their efficacy can be better gauged by simulation; thus, it provides better objective assessment and fairness for judging and even helps establish more accurate metrics, in this manner it is a sophisticated and reliable tool⁴. It also helps establish protocols for emergency procedures.⁴

As Otorhinolaryngologists, tracheostomy and endotracheal intubation are lifesaving critical procedures that we perform on a day-to-day basis hence use of simulation training for the same has been studied by us. There have been studies showing that simulation training helped students acquire the surgical skills better than learning by observation⁵.

Systematic reviews done of more than 600 studies regarding simulation technology as well as training using simulation among health care providers have shown that this technology is associated with significant improvements in learners' knowledge, skills, confidence and also better patient outcomes.⁵ There are different categories of simulators as follows, virtual reality models, synthetic bench models, human cadaveric simulators and lastly animal models (live of tissue).^{5,6} Endotracheal intubation is not always as easy as it appears, due to variation of several anatomical factors from patient to patient, so at times it may become difficult for the doctor to successfully secure the ET tube, which is a lifesaving procedure hence practicing with simulation techniques helps to expose one to a variety of possible challenges one might face, making one better prepared to face any case that might present in practice³.

Likewise, tracheostomy also requires great precision and speed, as it is a lifesaving procedure and has grave risks which makes it further more essential for one to master it on models before performing it on patients. In this manner otorhinolaryngologists must be highly skilled in handling all acute airway emergencies especially tracheostomy and emergency endotracheal intubation, simulation training offers a solution to ensure this skill development without risk to patients and by improving confidence of the surgeon^{4,6}.

Here in our study, we have used this technique of simulation using mannequins and OSATS to evaluate the applicability and effectiveness of this method of teaching and learning in development of emergency skills for airway management among otorhinolaryngology post-graduates.

II. Aim

To assess the practicality of simulation training in developing skills of endotracheal intubation and tracheostomy among post graduates in otorhinolaryngology, using the modern evaluation technique of OSATS.

III. Materials And Methodology

The study was conducted in the clinical skill lab of Department of Otorhinolaryngology after taking informed consent from the postgraduate students participating in the study. A cross-sectional study was done for a period of 1 year between August 2020 to September 2021. Eleven 1st year and Eleven 2nd year post-graduate students and five 3rd year postgraduates which is a total of 27 post-graduate students were included in the study.

Endotracheal intubation and tracheostomy were the two skills taught by simulation technique and then assessed using **OSATS** (Objective structures assessment of techniques).

First, a pre-test was conducted for all participants by qualified faculty prior to teaching and then the students were taught both the procedures by demonstration on the mannequins. **Second** assessment of the skills and theory knowledge regarding the same was done immediately after teaching and demonstration on the mannequins. Following which they were asked to perform them individually on mannequins by giving them several imaginary scenarios to work with. All the deficits were corrected by qualified staff and students were made to repeat until the skills were performed by the correct technique. A **third** assessment was done after 15 days in the form of a **retention test**. The same questionnaire was used in all tests in order to compare them efficiently.

In this way their skills were assessed after teaching by simulation technique on day 1 (represented as D1) using OSATS, both before and after teaching with a check list. Once again after two weeks that is on day 15 (represented as D2), the students were assessed in the similar way on the basis of their technical skills, knowledge and confidence levels with respect to these 2 emergencies. The questionnaires given on day 15, were labelled as a retention test “D2”.

The OSATS (Objective structures assessment of techniques) is a newer assessment method similar to **OSCE (Objective structured clinical examination)** which is shown to be efficient in skill assessment across several specialties in medical education and examinations and was employed in this study.

At the start of the study the students' perception of the skills taught was assessed using the **Five-Point Likert scale** ranging from strongly disagree “1” to strongly agree “5” and the results of the same was expressed using percentages. The difference in the scores of the post-test held, on the same day immediately after teaching and demonstration and again in the retention test held at the end of day 15 were compared & assessed using paired t-test.

The mean scores and standard deviation were calculated and the higher scores implied more agreement for using simulation methods for teaching such skills, as compared to low scores which implied less agreement towards the same. The data assimilated was analysed statistically. Paired T -test and simple percentages were used to access the data which was then expressed in the form of graphs and results were interpreted as follows.



FIGURE 1- red arrow- the tracheostomy procedure being done on the mannequin in a simulated setup; yellow arrow- the postgraduate student; green arrow qualified and trained ENT surgeon teaching the skill via simulation training

IV. Results

The study population was of 27 postgraduate's students of Otorhinolaryngology at our tertiary care centre, of whom 40.74 % belonged to 1st year and 40.74% to 2nd year, and 18.5% to third year.

The **percentage increase in confidence** in performing the given emergency procedures as well as, **knowledge with regards to tackling** these emergencies was found to have increased by D2 as compared to D1 significantly, with a **p<0.001** and has been represented graphically as shown below figure2.

Confidence level was having a mean of 32.4% by the day 15 at the time of the retention test, the **paired T test** gave **t=46.6 with a p of <0.001**, showing high significance.

Likewise, upon assessment of the knowledge there was an increase in knowledge gain not only immediately before and after the session by also as seen at the time of the retention test, we noticed a further increase by 40 %, with a paired t-test value of 29.592, p<0.001 again proving to give significance shown in figure 3.

Thus, we found that this method of teaching not only gave immediate better comprehension and understanding but also the knowledge was retained longer by the learners and concept was established, as seen at the time of checking the retention test.

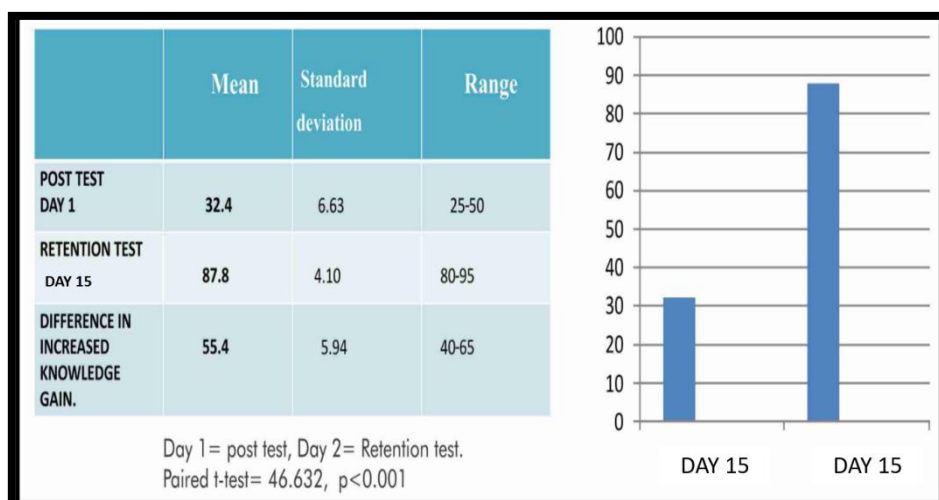


FIGURE 2 – PERCENTAGE INCREASE IN CONFIDENCE LEVEL

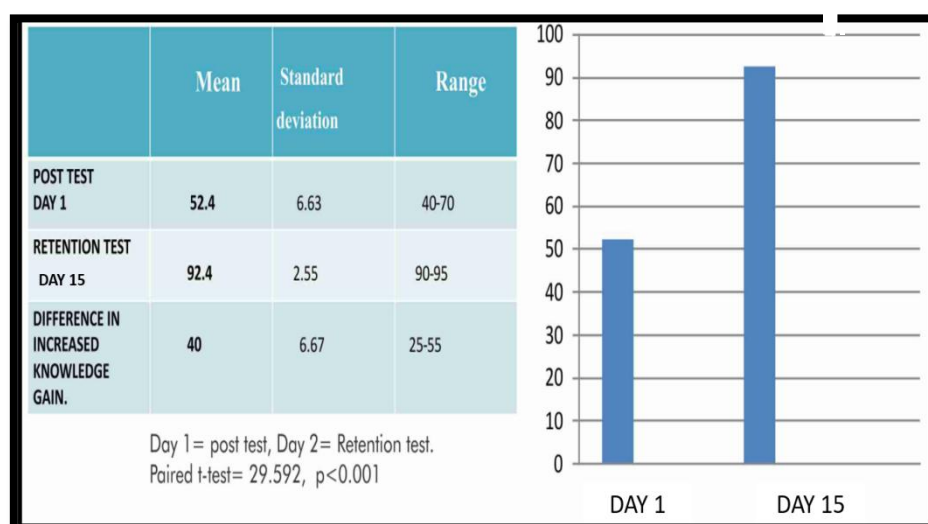


FIGURE 3 – PERCENTAGE INCREASE IN KNOWLEDGE GAIN

V. Discussion

Simulation as a method for teaching and learning has recently been adapted in the medical field following its use in other fields such as aviation and its immense success among the trainees^{7,8}. Performance of high-risk procedures and emergency care by inexperienced clinicians puts the patients at risk amounting to poor outcome and inefficient care, in spite of observation of the technique the performance of the procedure is difficult, thus in order to bridge this gap simulation can be used, for inexperienced health care providers to master the skill in a risk-free environment, before attempting the procedures on patients.⁷ Especially in critical care simulation learning has been seen to be highly effective.¹⁸

While technology-enhanced simulation is effective, increasing technological sophistication of simulation may not always be necessary. The key features of successful simulation education are those of successful curricula in general: *individualized feedback, cognitive interactivity, deliberate practice, and longer duration of the curricula.*⁹

Simulation itself can be of different forms, part task simulators are just a specific anatomical model like that of the limb for specific procedures, or full body mannequins, virtual reality simulation and lastly full-fledged OT setups with trained actors for simulation of the complete real-life situation, depending of the skill and the needs^{10,11,12,16}. Simulation helps to bridge the gap between reality and learning as seen in the study by Weller et al.¹³

Medical training can be transformed from the outdated "See One, Do One, Teach One" approach to a successful "See One, Practice Many, Do One" paradigm with the aid of medical simulation tools. According to Edgar Dale's theory, which is supported by the DALES CONE which we have schematically represented (figure 4), learners retain more information through what they "do" rather than what they "hear," "read," or "observe."¹⁴

RELEVANCE AT PRESENT PRACTICE OF ENT

In the light of the recent COVID-19 pandemic number patients with airway related emergencies had exponentially risen for which, the ENT surgeons were called upon and studies done at that time, showed that simulation training given proved to be very useful for them to perform mass procedures and gain confidence, also giving them an opportunity to come across a variety of plausible complications and scenarios for practice before facing the cases.¹²

Mathew et al conducted a randomized control trial for training junior ENT doctors in emergencies and have demonstrated how simulation training was faster than the conventional methods, helping in repetitive training and situation analysis for less familiar situations.^{13,14} Yanxia Sun et al in their study have concluded that not only does simulation-based learning help improve the skill of the learner but also increases the interest in the subject and provided better satisfaction of learning that further behaves as a form of motivation for the individual.¹⁵

ASSESSMENT METHODS

The **OSATS** is an examination using bench model simulation, consisting of two components: an operation-specific checklist and a global rating scale. Both of these methods were reported to be proportional to the maturity of surgical skills.¹⁶ In particular, the global rating scale is a common method of evaluation, not limited to any specific procedures, which consists of seven evaluation items scored on a 5-point scale thus this global rating scale can be applied to any other skill assessment.¹⁷ we have thus adapted the same system in our study for analysis of the use of simulation methods.

Simulation technique is not only used for clinical skills but also surgical skill development, facing variations, and developing teamwork and coordination as well. **PEARLS (Promoting Excellence and Reflective Learning in Simulation)** is a form of simulation which hallows one to focus of the directives of feedback and it also analyses the teaching technique, it emphasises on facilitating objectives which are cantered. Studies done have followed the **PDSA cycles (plan, do, study, act)** and have found that use of simulation by using mannequins has been highly effective.^{19,20}

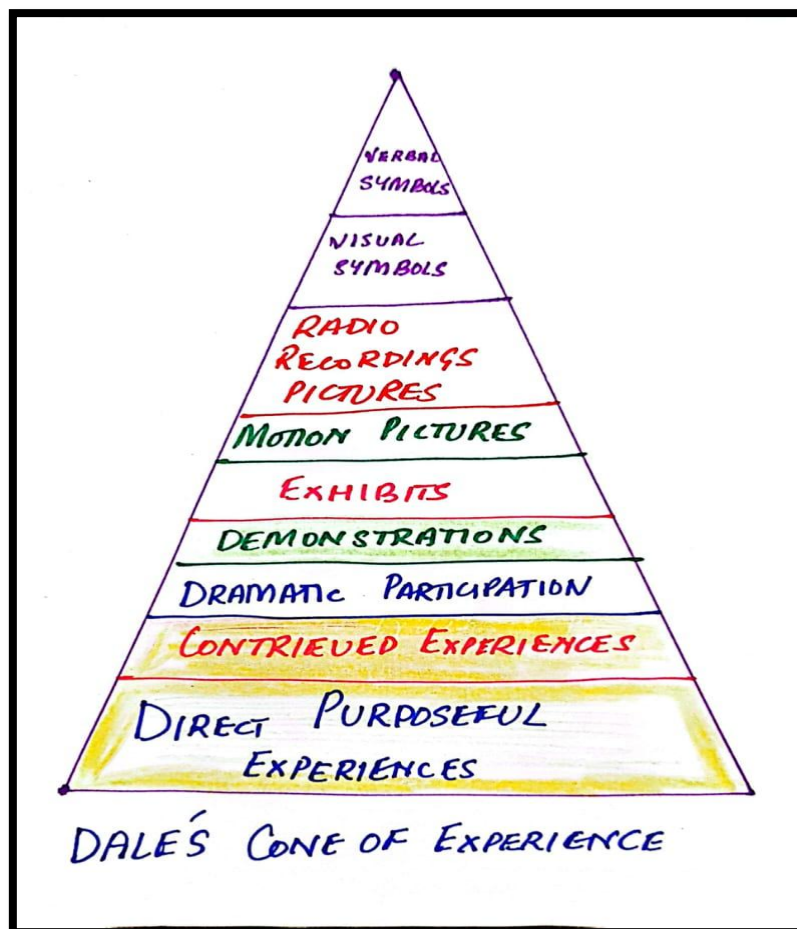


Figure4 -SCHEMATIC DIAGRAM OF DALES CONE OF EXPERIENCE

FIDELITY IN SIMULATION

Based on fidelity we have 2 types in simulation technology in health care. High fidelity mannequins are complex mannequins, they are called as human patient simulators or high-fidelity simulators they are designed to mimic human anatomy and physiology^{19,20}. Whereas a static or a low fidelity mannequin has limited functionality used for repeated practice of clinical skills.²¹The majority of high-fidelity mannequins have expanding, breathing chests, changing heart rates and tones, quantifiable blood pressure, and palpable pulses thus ensure greater simulation for learners.

The effect of high-fidelity technology-enhanced simulation remains controversial, and although the cost of such high-technology simulators is decreasing, their high costs may deter increasing use of this approach until more definitive evidence emerges.²¹Basak et al. studied the use of high- and low-fidelity mannequins in nursing simulation and found that satisfaction and confidence in learning are higher in simulations using high-fidelity mannequins than in those using low-fidelity mannequins, they even observed that the confidence of caregivers even among nursing staff had significantly improved with the use of simulation.^{22,23}We used low fidelity models at our setup yet, though mimicking of distress and other features would have probability increased the efficacy.

SIMULATION FOR CAREGIVERS AND HEALTHCARE WORKERS

Simulation techniques have been found highly beneficial even for teaching care givers at home, Kara Pricketta et al and few others have used highly configured models with ability to simulate stridor, cyanosis and several other features to teach mothers and caregivers of infants and elders who are tracheostomized.^{4,23,24}

VI. Conclusion

Airway management is an essential skill for medical practitioners especially Otorhinolaryngologists and use of simulation training in addition to the traditional methods of instruction in airway management the learners benefit with an intensive training in a low-risk setup with development of the emergency skills and improvement in the confidence of performing the procedure as well as technical knowledge regarding airway management. Simulation teaches things which are difficult for all students to learn in real scenarios which are the need of the hour.

In our study we have assessed not only the immediate response of the learners but also how much of the skill and knowledge they have retained after 2 weeks so in this manner even further long-term assessments will help us conclude the use of this method. Assessment was done using the efficient method of **OSATS**. Bearing in mind ethical concerns and safety of the patients it is only justifiable that in the practice of modern medicine simulation training must be used to train learners until they become confident in the critical procedures and their protocols and master the skills of these procedures. In the primary healthcare sector, simulation can be utilised to boost staff confidence in performing life-saving procedures.

LIMITATIONS

The study had a limited sample size and was conducted among students who were having different degrees of exposure and knowledge due to few being fresh residents as against others who were already performing the skills in patients regularly and hence not completely comparable. Larger studies with more complex variants are needed for detailed analysis of the applicability of simulation-based techniques to ENT emergencies.

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COMPLIANCE WITH ETHICAL STANDARDS

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Declaration

CONFLICT OF INTERESTS: The authors declare that they have no conflict of interests.

ETHICAL APPROVAL:

Institutional ethical committee approval was obtained for the conduction of this study. All procedures performed in the studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

INFORMED CONSENT FOR PARTICIPATION:The participants had full mental capacity to understand and comprehend the study, also the objectives and the methodology were clearly explained to all the participants following which informed and written consent was obtained for participation from all the participants.

CONSENT OF PUBLICATION: written and informed consent for publication was obtained from the participants as per the guidelines of the institution and the journal prerequisites.

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