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Using simulators to teach pediatric airway procedures in an international setting

Marissa A. Schwartz^a, Katherine R. Kavanagh^b, Steven J. Frampton^c, Iain A. Bruce^{d,e}, Tulio A. Valdez^{f,*}^a University of Connecticut Health Center, Otolaryngology, Farmington, CT, USA^b Connecticut Children's Medical Center, Otolaryngology, Hartford, CT, USA^c Portsmouth Hospitals NHS Trust, Cosham, Portsmouth, UK^d Division of Infection, Immunity and Respiratory Medicine, School of Biological Sciences, Faculty of Biology, Medicine and Health, University of Manchester, UK^e Paediatric ENT Department, Royal Manchester Children's Hospital, Central Manchester University Hospitals NHS Foundation Trust, Manchester Academic Health Science Centre, Manchester, UK^f Stanford University Department Otolaryngology, Palo Alto, CA, USA

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ABSTRACT

Introduction: There has been a growing shift towards endoscopic management of laryngeal procedures in pediatric otorhinolaryngology. There still appears to be a shortage of pediatric otorhinolaryngology programs and children's hospitals worldwide where physicians can learn and practice these skills. Laryngeal simulation models have the potential to be part of the educational training of physicians who lack exposure to relatively uncommon pediatric otorhinolaryngologic pathology.

Objectives: The objective of this study was to assess the utility of pediatric laryngeal models to teach laryngeal pathology to physicians at an international meeting.

Methods: Pediatric laryngeal models were assessed by participants at an international pediatric otorhinolaryngology meeting. Participants provided demographic information and previous experience with pediatric airways. Participants then performed simulated surgery on these models and evaluated them using both a previously validated Tissue Likeness Scale and a pre-simulation to post-simulation confidence scale.

Results: Participants reported significant subjective improvement in confidence level after use of the simulation models ($p < 0.05$). Participants reported realistic representations of human anatomy and pathology. The models' tissue mechanics were adequate to practice operative technique including the ability to incise, suture, and suspend models.

Conclusion: The pediatric laryngeal models demonstrate high quality anatomy, which is easy manipulated with surgical instruments. These models allow both trainees and surgeons to practice time-sensitive airway surgeries in a safe and controlled environment.

1. Introduction

Over the past decade there has been a transition to endoscopic management of pediatric airway conditions [1]. While in traditional open procedures both the attending surgeon and the trainees have direct access to the surgical field, this does not occur in endoscopic or microscopic cases. This shift in surgical approach has created a need to improve resident training in pediatric endoscopic laryngeal, tracheal, and bronchoscopic conditions.

Simulations are an integral part of medical education to practice clinical scenarios or allow residents to learn surgical procedures. Due to

limited resident work-hours, these simulations also help mitigate a reduction in educational opportunities. Various simulation models have been suggested including animal models, manikin models, and cadaveric models to practice surgical techniques [2,3]. Simulation models for otorhinolaryngology training, even simple models such as for myringotomy and tympanostomy tube placement created from common medical equipment, are thought advantageous to the resident learning process [4].

Airway management may be one of the most difficult skills to teach in pediatric otorhinolaryngology. Inexperienced physicians may have significant difficulty in managing acute airway emergencies. Airway

* Corresponding author. Stanford University, Department of Otolaryngology-Head and Neck Surgery, 801 Welch Road, Palo Alto, CA, USA.
E-mail address: Tvaldez1@stanford.edu (T.A. Valdez).



Fig. 1. Views of laryngeal surgical simulation model assembled and disassembled.
Legend: Left-Disassembled; Middle-Assembled Top View; Right-Assembled Inside View.

foreign body removal is an example of such an emergency situation, to which residents often have little exposure during residency due to chance. Previous studies using manikin simulation models have proven efficacious to improve resident confidence and skill for airway foreign body removal [3].

In the United States the number of accredited pediatric fellowships has increased significantly over the last 10 years. As part of fellowship training, endoscopic laryngeal procedures are commonly taught for a wide variety of conditions. However, worldwide the number of free-standing children's hospitals and Pediatric Otolaryngology training programs vary widely by geography. This variability and shortage in certain areas create a need for exposure to educational opportunities, such as at international meetings, where simulation stations and experts in the field can introduce and train physicians in new techniques in a controlled environment.

We have previously described modular airway models simulating pediatric laryngeal pathology (Fig. 1). These models demonstrated high quality anatomic resemblance with tissue characteristics similar to human tissue, proving a valuable tool for surgical simulation [5]. The purpose of this study was to assess the utility of these pediatric laryngeal models in teaching the surgical management of laryngeal pathology to international physicians in the setting of an international pediatric otolaryngology meeting.

2. Materials and methods

The study was approved by the Institutional Review Board at the Connecticut Children's Medical Center. Thirty minute microlaryngeal simulation station sessions were provided over two days at the European Society of Pediatric Otolaryngology (ESPO) in Lisbon, Portugal, to registered participants.

Previously described laryngeal models featuring different pediatric conditions including laryngeal cleft, laryngomalacia, and subglottic stenosis were assessed by participants. Each attendee was provided with two different models (representing one of the three pathologies) for 15 minute sessions each with instruction provided on laryngeal cleft repair, supraglottoplasty, and incision and balloon dilation by an experienced pediatric airway surgeon (KK, TV, IB) (Fig. 2). All participants were then invited to complete post-simulation questionnaires. Demographic information and previous experience with pediatric airway surgery were assessed. Participants evaluated the models using a validated Tissue Likeness Scale and compared their level of confidence pre-simulation to post-simulation [5]. We provide descriptive statistics on the demographic information and a two-sample paired *t*-test using SPSS 22.0 (SPSS Inc. Chicago, Illinois) on the level of confidence before and after the simulation intervention.

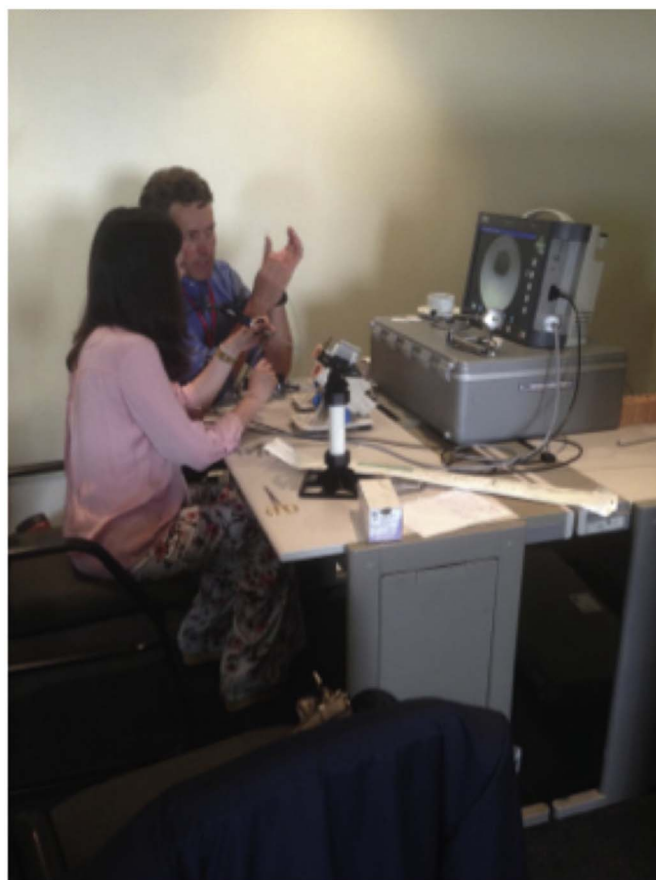


Fig. 2. Simulation with instructor at international conference.
Legend: Participant being guided by experienced instructor during session with simulation model using telescope.

3. Results

A total of 19 participants took part in the laryngeal surgery simulation study and, of those participants, 16 completed the entirety of the questionnaires. Participants consisted of otolaryngologists with various degrees of training and professional experience including residents, practicing otolaryngologists, fellows, and a department chairman. All participants used the laryngeal cleft model and chose a second, either the laryngomalacia or the subglottic stenosis model.

There was great variability in previous experience with pediatric airway cases, with an average of three cases performed in the last year and a range from 0 to 18 cases. Participants originated from a total of nine different countries with the majority of the participants originating

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