Comprehensive Reference Tools for Modern Airway Evaluations

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Abstract

Objectives: The most common airway devices encountered by Otolaryngologists are endotracheal tubes (ETTs), tracheostomy tubes (TTs), telescopes, and rigid bronchoscopes (RBs). We sought to develop a comprehensive airway evaluation reference card and corresponding operating room (OR) reference poster containing photographs of the relevant airway anatomy, and the size, inner diameter, outer diameter, length, and suction depth of these devices in relation to patient age, size, and expected airway caliber, to help clinicians select the appropriate equipment for a given patient.

Methods: A comprehensive search of medical product literature was performed. All dimensions for the rigid bronchoscopes and HOPKINS® telescopes were obtained from Karl Storz-Endoskope Inc. (https://www.karlstorz.com). Dimensions for Mallinckrodt™ endotracheal tubes and Shiley™ tracheostomy tubes were obtained from Covidien Inc. (http://www.covidien.com). Dimensions for Bivona® telescopes were obtained from Smiths Medical Inc. (http://www.smiths-medical.com). An Otolaryngology nurse with significant experience in the management of bronchoscopic anomalies was used to carefully measure the airway anatomy. In collaboration with that artist the compiled figures and images were formatted to create the airway reference card. Endoscopic images from The Hospital for Sick Children in Toronto were used in the creation of the OR reference poster. This information was evaluated by the author team to ensure accuracy from both a technical and experiential perspective.

Results: We have generated an airway reference card and a corresponding OR poster detailing the specifications of ETTs, Shiley™ and Bivona® TTs, as well as Karl Storz® telescopes and RBs for use as quick reference tools in both the operating and clinic settings.

Conclusion: The comprehensive airway evaluation reference card and poster serve as quick reference tools for assisting Otolaryngologists in determining appropriate airway equipment.

Introduction

The modern comprehensive pediatric airway evaluation is performed by endoscopically sizing the narrowest portion of the airway using un-cuffed endotracheal tubes as described by Myer et al (1994). Such data can then be compared to age adjusted normal values to determine the percentage of airway obstruction for a given patient and corresponding grade of airway stenosis. This system is a simple and efficient way to document and monitor pediatric airway lesions and their responses to various interventions.

Many different types of airway devices may be used while caring for children with airway disorders, such as endotracheal tubes (ETTs), tracheostomy tubes (TTs), telescopes, and rigid bronchoscopes (RBs). However the nomenclature used to document the size of these various airway devices is not standardized. For example, the size of ETTs corresponds to the inner diameter of the ET while size of the RBs does not correspond to the inner or outer diameter of the RB or a similarly sized ET. The lack of a standardized airway device sizing convention can create confusion in the operating room and often requires the surgeon to pause from the procedure in order to look at the dimensions of the specific airway device prior to or during use. This is clearly not an ideal situation given the technical complexity and often also the acuity of both endoscopic and open airway procedures.

Rothschild (1994) addressed the above concern in a publication in which the author created a diagram outlining the sizes of the various ETTs, TTs, and RBs based on their outer diameters. The current publication represents our efforts to refine and update that diagram in order to create a modern reference tool to assist Otolaryngologists to quickly identify the appropriate airway device for any given patient. We envision such a tool could be reproduced as both a pocket reference card as well as a poster that could be placed in the operating room.

Methods

A comprehensive search of medical product literature was performed. All dimensions for the rigid bronchoscopes and HOPKINS® telescopes were obtained from Karl Storz-Endoskope Inc. (https://www.karlstorz.com). Dimensions for Mallinckrodt™ endotracheal tubes and Shiley™ tracheostomy tubes were obtained from Covidien Inc. (http://www.covidien.com). Dimensions for Bivona® telescopes were obtained from Smiths Medical Inc. (http://www.smiths-medical.com). An Otolaryngology nurse with significant experience in the management of tracheostomy tubes compiled the appropriate suction caliber and depth for the various tracheostomy tubes. The data collected on the airway devices were then aligned using the inner diameter of an endotracheal tube as a reference. After obtaining Institutional Review Board exemption, endoscopic images of a normal pediatric supraglottis, glottis, subglottis, trachea, and interarytenoid region were obtained from the medical record at Seattle Children’s Hospital. Additional images outlining the details of the Cotton-Myer grading system for subglottic stenosis were included after obtaining permission from the authors. A graphic artist created a diagram of the bronchial anatomy from collaboration with that artist the compiled figures and images were formatted to create the airway reference card. Endoscopic images from The Hospital for Sick Children in Toronto were used in the creation of the OR reference poster. This information was evaluated by the author team to ensure accuracy from both a technical and experiential perspective.

Results

We have created a comprehensive airway evaluation reference card and OR poster by compiling the most up to date dimensions of endotracheal tubes (ETTs), tracheostomy tubes (TTs), telescopes, and rigid bronchoscopes (RBs) as well as representative airway endoscopy photos. This includes a swinging hook technique for inter-Arytenoid Region Assessments.

Conclusions

We have created a comprehensive airway evaluation reference card and OR poster by compiling the most up to date dimensions of endotracheal tubes (ETTs), tracheostomy tubes (TTs), telescopes, and rigid bronchoscopes (RBs) as well as representative airway endoscopy photos. This includes a swinging hook technique for inter-Arytenoid Region Assessments. The purpose of this tool is to aid in the quick identification of appropriately sized airway devices during pediatric airway surgery. We hope to make this reference available online so that institution specific pocket cards and operating room posters can be generated.

Acknowledgements

Julie Sharples, RN, Seattle Children’s Hospital, for compiling the data on suction caliber and depth for the various tracheostomy tubes.

References: