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Research Article

Assessment of Resident's Skills to Perform Endoscopic Sinus Surgery

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Abstract

Context: Although, endoscopic sinus surgery (ESS) is a standard procedure, in the hands of inexperienced trainees it may involve risks for the patients.

Objective: To assess the surgical skills to perform ESS of Otolaryngology residents by year, in a tertiary referral center.

Methods: A cross-sectional study was performed. After designing an ad hoc tool of 9 items, with a 3 point Likert rating scale, 2 faculty rhinologists scored the performance of 35 residents during the first six months of their training year in a standard program.

Results: The assessment tool showed good internal consistency and construct validity, discriminating among residents by year of training (ANOVA, p <0.05), with good reliability (Chronbach alpha 0.85, p <0.05) and correlation among the items (Kaiser-Mayer-Olkin test 0.66, p <0.05), and two dimensions: the first one including the skills to manipulate the instruments, and to perform nasal exploration and preparation for surgery, uncinectomy, maxillary antrostomy and anterior ethmoidectomy; the second one to perform posterior ethmoidectomy, sphenoidostomy and frontal sinusotomy. Basic skills were achieved by 100% of the residents at the beginning of the 3rd year of training. The ability to perform uncinectomy, maxillary antrostomy and anterior ethmoidectomy was observed in 100% of the residents at the 4th year of training. However, performance of the most challenging procedures was broadly variable among senior residents.

Conclusion: The assessment of skills of residents to perform ESS should be done systematically in order to provide individual feedback and to update training programs, within the context in which each program is executed.

Keywords

Endoscopy; Surgeryl; Paranasal sinuses; Residency; Clinical competence; Skills; Training

Introduction

Endoscopic sinus surgery (ESS) has undergone rapid development over the past three decades. Surgical competency is imperative because of both, the complexity of the sinus anatomy and the difficulty in manipulating instruments. Although, it is a standard procedure, in the hands of inexperienced trainees it may involve risks for the patients, and increase complications [1].

Residents acquire their surgical skills through direct observation and repeated practice. During training, surgical skills are usually evaluated by faculty assessment, according to attainment during rotations, instead of using performance standards. In order to monitor educational programs and provide trainee feedback, the design and implementation of objective mechanisms to measure the surgical skills of residents are desirable [2]. In addition, to determine competency, assessment of surgical skills should be done according to the specific goals or "milestones" of the training program [3].

The aim of this study was to assess the surgical skills to perform ESS of Otolaryngology residents, in a standard training program, using a tool designed ad hoc to identify their performance by year.

Methods

The study protocol was approved by the Research and Ethics Committee of the Institution (R2017-1302-34).

Participants. At 2 Medical Centers from the same Institution, at the end of each procedure of ESS, two faculty rhinologists scored the performance of 35 residents during the first six months of their training year. The mean surgical experience on ESS of the residents by training year was of 2 (SD 0.5) ESS procedures at first year (n=9); 5 (SD 2.1) at 2nd year (n=11), 7 (SD 2.7) at 3rd year (n=8), and 8 (SD 0.4) at 4th year (n=7). All the residents were under the same training program, which comprises a cadaver dissection course during the 2nd year of training. The final ESS goals of the program include competency on maxilar antrostomy, anterior ethmoidectomy, posterior ethmoidectomy and sphenoidostomy.

Tool design. According to the standardized technical steps to perform ESS, the procedure was deconstructed into sub-tasks for assessment analysis. The subtasks were assembled into eight assessable tasks of 3 subtasks each, and a complementary item to assess the skills in manipulating instruments (Table 1). Then, a panel of 5 independent rhinolologist evaluated the list of tasks, using Delphi technique [4], until >70% of agreement was achieved.

The resulting list was used to design a tool of 9 items, with a 3-point Likert rating scale. A score was given to each item, as follows:

For the skills in manipulating the endoscope and instruments, when used without damage to any structure = 3, with damage to one nasal structure = 2, with damage to 2 or more nasal structures= 1.

For the 8 surgical tasks: when the 3 subtask were performed adequately ("Performs the task with dexterity") = 3 points, when two of the 3 subtask were performed adequately ("Performs the task with relative difficulty") = 2, and when one or none of the subtask were performed adequately ("Not able to perform the task") = 1.

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Table 1: Freqsuency of score ≥2, mean and standard deviation of score for each task, by year of training, whenever scoring was applicable.

Tasks	(Number of times when scoring was applicable) Frequency of score ≥2 Mean ± standard deviation of individual scores			
	1st	2nd	3rd	4th
1. Manual skills. Use of the endoscope and instruments without damage to nasal structures.	(n=9) 55% 1.78±0.83	(n=11) 81% 2.27± 0.79	(n=8) 87% 2.50±0.75	(n=7) 100% 2.71±0.48
2. Nasal exploratory endoscopy of the: a) nose floor. b) middle meatus. c) spheno-ethmoidal recess and olfactory region.	(n=9) 55% 1.56±0.53	(n=11) 90% 2.09 0.54	(n=8) 100% 2.62±0.51	(n=7) 100% 2.71±0.48
3. Intranasal preparation for surgery a) placement of cotonoids with anesthetic/vasoconstrictor. b) injection of local anesthetic in the lateral nasal wall and middle meatus. c) middle turbinate medicalization.	(n=9) 55% 1.78±0.83	(n=11) 90% 2.36± 0.67	(n=8) 100% 2.87±0.35	(n=7) 100% 2.85±0.37
4. Uncinectomy a) identification of the uncinate process and its boundaries. b) incision of the uncinate process with backbiter or sickle knife. c) removal of the uncinate process.	(n=7) 14% 1.14±0.38	(n=11) 45% 1.64± 0.81	(n=8) 75% 2.25±0.88	(n=7) 100% 2.57±0.53
5. Maxillary antrostomy a) identification of the natural ostium of the maxillary sinus. b) enlargement of the natural ostium towards the posterior fontanelle. c) identification and removal of the infra-orbital maxillary cells.	(n=7) 14% 1.14±0.38	(n=11) 72% 1.91± 0.70	(n=8) 75% 2.13±0.83	(n=7) 100% 2.71±0.48
6.Anterior ethmoidectomy a) identification of the bulla ethmoidalis. b) removal of the bulla with mucosal preservation. c) removal of the anterior ethmoidal cells with identification of its boundaries.	(n=7) 0% 1±0.	(n=10) 30% 1.3±0.48	(n=8) 75% 2.0±0.76	(n=7) 100% 2.43±0.53
7. Posterior ethmoidectomy a) entrance to the posterior ethmoid cells through the basal lamella, with preservation of the horizontal strut. b) removal of the posterior ethmoid cells, with identification of the skull base and superior turbinate. c) If present, to identify and open the retro-maxillary cells.	(n=7) 0% 1±0	(n=10) 22% 1.22 0.44	(n=4) 50% 1.5±0.58	(n=5) 60% 1.8±0.84
8. Sphenoidostomy a) entrance to the sphenoid cells through the ethmoid cells or the natural ostium. b) enlargement of the sphenoid ostium and removal of the sphenoid rostrum. c) identification of internal carotid, optic nerve, sellar region, inter sphenoid septum, optico-carotid recess.	(n=6) 0% 1±0	(n=9) 11% 1.22 0.67	(n=3) 33% 1.33±0.58	(n=5) 60% 1.8±0.84
9. Frontal sinusotomy a) removal of the cells in the frontal recess. b) identification of the anterior ethmoid artery and the drainage pathway of the frontal sinus. c) frontal sinusotomies.	(n=6) 0% 1±0	(n=9) 11% 1.11± 0.33	(n=3) 33% 1.33±0.58	(n=5) 60% 1.6±0.55

A total score was given by the sum of scores of each item, up to 27. However, if the procedure was not required (NA= not applicable), 0 points were given.

Statistical analysis: The internal consistency of the evaluation tool was assessed using Chronbach alpha and construct validity was assessed using analysis of variance, after Kaiser-Mayer-Olkin test. Principal component analysis was also performed. Significance level was set at 0.05.

Results

The tool designed to assess resident skills to perform ESS showed good internal consistency and construct validity, discriminating among residents by year of training. Analysis of variance showed increase of the total score by year. The mean (standard deviation) score for the 1st year was 9.6 (1.73), for the 2nd year 15.4 (3.8), for the 3rd year 17.25 (2.7), and for the 4th year it was 20.8 (2.73) (ANOVA, $p < 0.01$). The reliability of the tool was high (Chronbach alpha 0.85); accordingly, there was good correlation among the items (Kaiser-Mayer-Olkin test 0.66). The principal component analysis showed two dimensions, the first including items 1 to 6, and the second including items 7 to 9.

A score increase by year of training was mainly observed on items 1 to 6 (Table 1). Basic skills to explore and to prepare for the surgery were achieved by 100% of the residents at the beginning of the 3rd year of training. However, the ability to manipulate the endoscope and the instruments was observed in 100% of the residents just at the 4th year, as well as the performance of uncinectomy, maxillary antrostomy and anterior ethmoidectomy (Table 1). Competence to perform posterior ethmoidectomy, sphenoidostomy and frontal sinusotomy was not achieved by all residents at the 4th year of training.

Overall procedures, there were 2 cases with a complication (5.7%), which occurred during procedures performed by residents at the 3rd year of training; in both cases the complication was penetration of the lamina papyracea with exposure of the orbital fat.

Discussion

In the current study we observed that basic skills on preparation to ESS were achieved by residents at the 2nd year of training, and competency to perform the less challenging procedures were evident at the 4th year. However, competency to perform the most challenging procedures was highly variable even at the 4th year of training. According to the complexity of the procedures, these results

are consistent with the evidence showing that manual skills are more easily achieved than spatial orientation [5].

Complications in ESS are variable. They can be classified as major and minor according to the degree of morbidity and treatment needed to prevent permanent sequels [6]. Among major complications are severe bleeding, injury of the skull base, and injury of the lachrymal lacrimal duct; while minor complications include diffuse or arterial bleedings and injury of the lamina papyracea [6]. Major complications occur in 0-1.5% of cases and minor complications occur in 1.1–20.8% [7]. In the United States of America, in a retrospective review of a data base of 62,823 patients, the major complication rate of ESS was 1% [8]. In this study there were no major complications. However, there were 2 minor complications, which could be related to low surgical experience of the residents on an area of particularly thin bone (lamina papyracea), where anatomical variations should be recognized before surgery [9].

Although residents completing their residency in otolaryngology are expected to be competent in performance of ESS, the skills acquired during a standard program of training may not be sufficient to perform all the procedures. In this study, after completing the first 3 years of training, the number of procedures performed by resident was less than 10. Evidence has shown that after performing 18 ESS procedures there is a 60% probability of competency in performing maxillary antrostomy and anterior ethmoidectomy, while performing 42 sinus surgeries may give the 60% probability of achieving competence for all steps of the ESS [3].

The results of the study suggest that, in order to achieve the goals of a training program, some residents may require more practice than others. In addition, specific learning modalities (e.g., lecture, animal laboratory, high-fidelity manikin, virtual bronchoscopy, standardized patient) may have different values for teaching airway management [10,11]. Then, complementary educational strategies may have to be implemented during training, according to a standardized assessment of the individual performance. These may include technological developments with computer-aided technical skill evaluation, which are still in need of validation in the operating room, against patient outcomes [12].

The main limitation of this study is its design. The cross-sectional design prevented us to discuss the progression of residents through the training years and allowed us to identify just the most evident differences among subgroups. In addition individual aptitude may have increased the variability within each subgroup.

In conclusion, in order to provide individual feedback and to update training programs, assessment of skills of residents to perform ESS should be done systematically, using objective tools and within the context of each training program.

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