Achievement of Competency in Endoscopic Sinus Surgery of Otolaryngology Residents

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**Objectives/Hypothesis:** The goal of our study is to identify the number of Endoscopic Sinus Surgery (ESS) cases required to obtain competency in ESS, using a previously validated assessment tool.

**Study Design:** Prospective observational study.

**Methods:** Seventeen residents from Johns Hopkins Otolaryngology–Head & Neck Surgery residency program were evaluated as they performed endoscopic sinus surgery in the operating room. Global and checklist parts of the ESS instrument were used for assessment purposes. Items on the tool were grouped into three different milestones for analysis of data (Milestone 1 = Maxillary Antrostomy + Anterior Ethmoidectomy, Milestone 2 = Posterior Ethmoidectomy + Sphenoidostomy, Milestone 3 = Frontal Sinusotomy). Residents were deemed competent if they achieved a minimum score of 3 on a 5-point Likert scale on each step of the surgery.

**Results:** A total of 73 evaluations were completed for 17 residents (Postgraduate Level 2–5) by eight evaluators between 2009 and 2011. A 60% probability of achieving competency in performance of all milestones of ESS is obtained with performing 42 ESS procedures and the probability is increased to a 100% with performance of 55 endoscopic sinus surgery procedures. On average it took residents 23 cases to become competent in performance of maxillary antrostomy and anterior ethmoidectomy.

**Conclusions:** Our results suggest that it requires 42 ESS procedures to attain a 60% probability of competency in ESS. These results have implications for otolaryngology residency programs when developing curriculum and benchmarks for the training residents.

**Key Words:** Learning curve, milestones, surgical assessment, endoscopic sinus surgery.

**Level of evidence:** NA

**INTRODUCTION**

Endoscopic Sinus Surgery (ESS) is one of the key procedures in Otolaryngology–Head & Neck Surgery on which the surgical management of paranasal sinuses and skull base pathologies is based. The residents completing their residency in otolaryngology are expected to be competent in performance of ESS. In Carr's survey of otolaryngology program directors, 50% of the program directors agreed that the resident should be competent in performing maxillary sinusotomy at postgraduate year (PGY) level 3.1 However, teaching ESS in residency programs is challenging because of the complex anatomy, proximity to vital structures, and limited operative field. Minor complication rate for ESS has been shown to be significantly higher in the residency programs when compared to nonresidency programs.2 Some experts suggest that trainees should have experience of 30 cadaver head dissections before performing ESS in operating room on live patients.3 Utility and transference of skills of virtual reality simulators and cadaver dissection courses has been the focus of many recent studies.4,5 This may allow for the achievement of a learning curve of the otolaryngology residents outside of the operating room and potentially minimize the patient complication rate. However, the minimum number of cases to achieve competency in ESS is only based on opinions and there has been no objective data or agreed minimal number described in the literature.

With the implementation of work-hour limitations and increased public awareness, the Accreditation Council of Graduate Medical Education (ACGME) has made major changes to its mandate, requiring training programs to ensure competence of the graduating residents. Previous studies have shown a mismatch between the number of reported performed cases by the residents and the number considered by experts as the minimum number to achieve competency in a certain procedure. The purpose of our study was to establish a learning curve for endoscopic sinus surgery and to translate that into number of cases required to achieve competency in ESS by an average resident.
MATERIALS AND METHODS

This study was performed over a 3-year time period after approval from the Johns Hopkins Institutional Review Board (IRB). We implemented global and checklist parts of the assessment tool for Endoscopic Sinus Surgery (ESS) as part of the Assessment of Surgical Competency in ENT (ASCENT) project. The ESS assessment tool has been previously validated by use in the laboratory and operating room.6

The ESS tool consists of a checklist part, which scores the residents’ performance on specific tasks of the surgery on the scale of 1 to 5, and a global part that assesses the performance on more generic tasks. A score of 3 and above is considered competent for that particular task.

After observing resident’s performance of endoscopic sinus surgery (or at least maxillary antrostomy) in the operating room, the global and checklist parts of the electronic evaluation were completed and submitted by the rhinology faculty into an online system. The residents at all times had some degree of supervision while performing the surgery, since they were being assessed for their performance in the operating room. For the purpose of our study we only included the cases that the residents had logged into the ACGME case log system, and had performed more than 50% of the case.

To identify the number of cases performed to achieve competency in different steps of the endoscopic sinus surgery; we grouped the items on the checklist scale into three milestones (Milestone 1 = uncinctectomy + maxillary antrostomy + anterior ethmoidectomy; Milestone 2 = posterior ethmoidectomy + sphenoidostomy; Milestone 3 = frontal sinusotomy). The items on the checklist assessment tool were grouped into three different milestones based on faculty opinion and similarity of the tasks in terms of complexity and level of skill required to complete the task competently.

Definition of Competency

The criteria used for attaining competence were achieving a minimum score of 3 out of 5 on all the items of the checklist and being deemed competent by the evaluator to perform the surgery independently.

Data Analysis

Collected data was analyzed using STATA 11.0 (StataCorp LP, College Station, TX) data analysis and statistical software package. We performed locally weighted scatterplot smoothing (LOWESS) regression analysis to analyze data. This type of nonparametric modern regression technique is used to model the relationship between a dependent and an independent variable in a way that makes no assumptions about the form of the relationship. This type of analysis is not affected by the outliers, making it ideal to detect trends in data sets like ours that may otherwise have too much variance, resulting in nonsignificant P values. For all statistical purposes, P < .05 was considered significant.

<table>
<thead>
<tr>
<th>Milestones</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>First milestone (uncinctectomy + maxillary antrostomy + anterior ethmoidectomy)</td>
<td>23.1</td>
<td>1–49</td>
</tr>
<tr>
<td>Second milestone (posterior ethmoidectomy + Sphenoidostomy)</td>
<td>22.5</td>
<td>1–49</td>
</tr>
<tr>
<td>Third milestone (frontal sinusotomy)</td>
<td>33</td>
<td>15–44</td>
</tr>
</tbody>
</table>

RESULTS

A total of 73 evaluations were completed for 17 residents by eight evaluators between 2009 and 2011 using global and checklists parts of the ESS assessment tools. The evaluators were full-time rhinology faculty at the Johns Hopkins Otolaryngology–Head & Neck Surgery (OHNS) residency program. Participating residents belonged to postgraduate year (PGY) levels 2–5.

We did not notice any significant difference in the number of cases taken to achieve competency in the first two milestones. It took a mean of 23.1 cases for a resident to achieve competency in performance of first milestone, and 22.5 cases for second milestone. Competency was achieved last in performance of third milestone (frontal sinusotomy), which required an average of 33 cases to perform the task competently (Table I).

Figure 1 shows the probability of becoming competent in all steps of the endoscopic sinus surgery with increasing number of cases. The probability of becoming competent reaches 60% with performing 42 cases, 80% with 51 cases and 100% with 55 cases. Plotting a lowess...
smoothing graph between number of cases performed by the residents and criteria of achieving competency in the first milestone showed that a 60% probability of competency in first milestone was obtained with performance of 18 ESS cases (Fig. 2).

DISCUSSION
The goal of our study was to establish a learning curve for endoscopic sinus surgery of an average otolaryngology head and neck (OHNS) surgery resident. Participants were residents from the Johns Hopkins OHNS program. The residents were evaluated for their performance of endoscopic sinus surgery by using the global and checklist parts of the endoscopic sinus surgery instrument, which has been previously validated.9

For purpose of analysis we grouped steps of the ESS into three different milestones. Previous studies have suggested that competence in performance of different steps of a surgery may be achieved at different times of rotation and training. Francis et al.7 showed in their study of otolaryngology residents that the number of cases needed to achieve competency in performance of each task of mastoidectomy varied from 6 days to 14 days depending on the complexity of the task. The authors further categorized the steps of the surgery into three milestones and suggested that the milestones be used as standard benchmarks against which the progress of an average trainee can be compared. For our current study we categorized the tasks of ESS into three different milestones based on the expert faculty opinion in order to evaluate the number of cases required to achieve competency in each ESS milestone.

Our results indicate that the probability of becoming competent in performing all cases of ESS reaches 60% with performance of 42 sinus procedures. A graduating otolaryngology resident, however, is expected to achieve competency in only “maxillary antrostomy” and “anterior ethmoidectomy” (first milestone). A survey of otolaryngology program directors also reported that program directors expect residents to become competent in performance of “maxillary sinusotomy” (first milestone) at postgraduate year (PGY) level 3.1 Our results indicate that a 60% probability of competency in performance of first milestone is achieved much earlier, with performance of 18 ESS procedures.

The Accreditation Council of Graduate Medical Education’s (ACGME) recent approach to outcomes-based education is the introduction of the “Milestones Project,” the goal of which is to evaluate residency programs on whether their residents are progressing towards competency. According to the ACGME 2008 bulletin8 “The milestones project brings together the ACGME, the Residency Review Committees (RRC) and the academic specialty communities to develop specialty-specific educational milestones, residents are expected to attain at specific times throughout their education”. Successful implementation of the milestone project by the residency programs would require the programs to regularly assess their residents and review their performance against the predefined milestones. Our current study is a pilot project for defining milestones for endoscopic sinus surgery, which can serve as a model for defining milestones for other competencies or skills. Identifying milestones for ESS will not only allow the programs to develop a goal-oriented curriculum for the residents, but also compare the progress of the residents against a predefined standard.

One of the weaknesses of our study is that the results are based on data from a single residency program and there is a potential for selection bias. Secondly, we had a small sample size of 17 residents and 73 evaluations, so we did not have sufficient data to develop learning curve for each step of the surgery. Lastly, since our study population was comprised of residents at different training levels within the residency program, their previous surgical exposure in terms of cadaver dissection courses, didactics, and other educational modalities varied greatly, and this did not allow us to perform a true standardization of the study population. Despite these weaknesses, this is the first study attempting to define milestones for endoscopic sinus surgery. We suggest that based on this model, a multi-institutional study should be performed so that a standardized set of milestones can be defined, and utilized by programs for developing curricula at the national level.

CONCLUSION
Our results indicate that a 60% probability of competency in performing maxillary antrostomy and anterior ethmoidectomy is achieved after performing 18 ESS procedures. However for all steps of the ESS, the 60% probability of achieving competence is obtained after performing 42 sinus surgeries. These findings can be used by the otolaryngology residency programs when developing benchmarks and milestones, and for monitoring a resident’s progress through their training in OHNS.

BIBLIOGRAPHY