Resident/fellow assistance in the operating room for endocrine surgery in the era of fellowships

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Background. Historically, a high percentage of endocrine surgical procedures are performed by general surgeons in nonteaching environments. With the institution of accredited fellowships, we sought to determine whether that dynamic is changing.

Materials and Methods. The American College of Surgeons—National Surgeons Quality Improvement Program was queried for all thyroid, parathyroid, and adrenal operations performed during 2005–2008. Resident assistance was classified as none, junior (postgraduate years 1–3), senior (postgraduate years 4 and 5) or fellow (≥ postgraduate year 6). Data were also examined for associations between resident/fellow assistance and surgical outcomes.

Results. In all, 24.7% of endocrine operations (7,140/29,161) were performed by an attending surgeon operating alone (17.1% adrenals, 27.4% thyroids, and 20.6% parathyroids). Fellows assisted in 6.6% of operations (18.3% adrenals, 4.7% thyroids, and 8.2% parathyroids; 2006: 586 operations, 2007: 629 operations, and 2008: 720 operations). Comparing attending surgeons operating alone with those assisted by residents/fellows, they had shorter operative times (P < .001), longer surgical duration of stay (parathyroid: 1.73 days, thyroid: 1.80 days, P < .001), and a higher prevalence of obese, diabetic, or octogenarian patients. However, no significant difference was found in the rates of wound infections, medical complications, return to the operating room, or overall morbidity.

Conclusion. Even with the increase in endocrine surgery fellowships, almost one fourth of all endocrine operations are still performed by attending surgeons operating alone. Although operations assisted by residents/fellows took longer and patients had a greater duration of stay, there were no significant differences in measured outcomes. (Surgery 2010;148:1065-72.)

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In 2010, approximately 80% of the more than 1,000 graduating surgical chief residents will seek subsequent training experience beyond their 5 years of clinical training during their general surgery residency.1 Many believe this is a consequence not only of national trends toward further subspecialization, but also, more importantly, it may reflect the increasing number of general surgery residents who feel unprepared to enter the surgical workforce in the 80-hour workweek era. A general consensus exists among surgeons that specialty fellowship training provides valuable experience in both operative skills and patient care that contribute to improved outcomes and less complications after surgical procedures.2

Few studies have examined the impact of fellowships on resident surgical training, one or two each in the fields of obstetrics/gynecology,3 urology,4 orthopedics, vascular surgery,5 and minimally invasive surgery.6 Almost all these studies were conducted as surveys and, therefore, have many limitations. Nevertheless, they all echoed that the addition of specific fellowships created an overall positive experience for residents; there was increased didactic learning, a fostering of mentorships, and interest in that specific career path, as well as no adverse impact on surgical outcomes or complications.

Endocrine surgery is recognized as an important subspecialty of general surgery. As of 2010, 15 advanced postgraduate fellowship training programs in the U.S. and Canada participate in a yearly match of applicants through the American Association of Endocrine Surgeons (AAES). In response
to 2 AAES presidential appeals (Prinz’s in 19967 and Pasieka’s in 20058), in 2005 the society ratified established criteria for fellowship curriculum development, with a standardized set of goals and objectives for all graduating fellows.9 These include demonstrating knowledge and understanding of the anatomy and physiology of the endocrine glands (thyroid, parathyroid, adrenal, endocrine pancreas, gastrointestinal tract hormones, and pituitary gland), inherited endocrine disorders, and current controversies in the literature and areas of research. Fellows are expected to diagnose clinical endocrinopathies, including performing neck ultrasounds and interpreting appropriate imaging or histopathology slides, and to perform surgical operations safely for each disease.

The total number of endocrine surgical procedures performed in the U.S. continues to increase as the incidence of endocrine disease rises. Sosa et al10 projected that in 2020, 97,700-173,509 endocrine operations would be performed. Additionally, in the 2004 Healthcare Cost and Utilization Project—National Inpatient Sample used, 1% of surgeons performed 24% of all operations, with similar results found by Saunders et al,11 who showed that surgeons whose practice was mainly endocrine comprised only 1% of the surgeons performing the most common endocrine procedures. In addition, many endocrine operations are not performed at large academic centers. For example, Bilimoria et al12 looked at thyroidectomies performed for thyroid cancer using the National Cancer Center Database and showed that only 8% of thyroid cancer patients were treated at a designated National Comprehensive Care Network/National Cancer Institute center, with another 41% at other academic hospitals and 59% at community hospitals.

We wondered whether the existence of endocrine surgery fellowships has led to changes in operative experiences and/or postoperative outcomes in endocrine surgical cases nationwide. Because the American College of Surgeons—National Surgeons Quality Improvement Program (ACS-NSQIP) is the only major national outcomes database (including the National Inpatient Sample (NIS) and Surveillance Epidemiology and End Results databases) that records the specific operating room characteristics of surgeon assistance in the operating room, we chose this database to investigate whether the operating room dynamics in endocrine surgery cases are changing on a national level. Are more surgeons operating with resident or fellow assistance, and, therefore, presumably in a larger, teaching environment as opposed to small private centers? In addition, we sought to determine whether assistance by residents and/or fellows impacts outcomes such as complications, operative times, and duration of stay.

**MATERIALS AND METHODS**

**Database.** Originally developed as a quality improvement initiative by the Veterans Health Administration in 1994, the ACS-NSQIP (http://www.acsnsqip.org/) is a prospective, multi-institutional, risk-adjusted outcomes program that provides participating hospitals with data for quality control review of outcomes.13 The general approach and methods of the National Surgical Quality Improvement Program database are described in detail elsewhere.14 Briefly, the program collects detailed data regarding patient demographics, preoperative risk factors, intraoperative variables, and postoperative outcomes that occur within 30 days of operative treatment. Dependent on each hospital’s overall volume, the sampling strategy allows participating hospitals to capture data for approximately 20% of their total number of eligible (major) cases at random. Thyroid, parathyroid, and adrenal operations are included in the major case sampling. Each patient’s data points are entered by an experienced paid data-entry NSQIP staff member. Data consistency and reliability are assessed annually for every hospital through an on-site audit during which an interrater reliability analysis is performed. Given the perceived value of outcomes data, there has been increasing numbers of participating hospitals in the NSQIP database since its inception: 121 hospitals were included in the 2005–2006 data set, 173 in 2006–2007, and 242 in 2007–2008.

**Data retrieval.** All patients who underwent major endocrine operations during the 3 most recent recording years (2005–2008) were identified. We queried the ACS-NSQIP database for all primary current procedural terminology (CPT) codes pertaining to thyroid (60210, 60212, 60220, 60225, 60240, 60252, 60254), parathyroid (60500, 60502, 60505), or adrenal (60540, 60545, 60650) operations using SAS statistical software (version 9.2; SAS Institute Inc., Cary, NC). We chose not to include endocrine pancreas cases for 2 main reasons. First, not all endocrine surgery fellowships include pancreas surgery as part of the training, so likely a high percentage of recorded fellow assistance would have been by surgical oncology fellows thereby skewing the data. Second, there is a possibility that coding of a particular pancreas resection would be given a CPT that would not place it within the category of “endocrine surgery” but rather within the general pancreas category and, therefore, not identified in an “endocrine surgery” NSQIP query.
Some variables that were not binary were regrouped and classified as follows (using NSQIP definitions): diabetes as none versus any patient on oral diabetic medication or insulin; dyspnea as none versus any; anesthesia technique as general versus other; American Society of Anesthesiologists (ASA) classes I and II were categorized as “mild” and classes III and IV as “severe”; all types of wound infection were grouped into one category. Body mass index (BMI) was calculated from height and weight variables, with “obese” defined as BMI >30. Resident assistance in the operating room was classified as none, junior (clinical PGY1-3), senior (clinical PGY4,5), or fellow (clinical PGY6 or higher). Missing values were not imputed.

Statistical analysis. Data were then examined for any association between resident assistance and surgical outcomes. Pearson Chi-square analyses were used for associations between categorical data and the Student t test was used for comparisons of continuous data. For both operative times and duration of stay, the effect of multiple predictors was controlled using multivariate regression, and a linear relationship was assumed. Analysis was performed with SPSS version 15.0 (SPSS Inc., Chicago, IL).

RESULTS

During the 3 years studied, NSQIP recorded a total of 29,161 endocrine operations; 1,781 adrenals, 9,101 parathyroids, and 18,279 thyroids. Overall, this represents a 20% sampling of all those operations at participating NSQIP participating hospitals. Stratified by year, in 2005-2006, there were 7,842 endocrine operations in the NSQIP database, to include 483 adrenals, 2,540 parathyroids, and 4,819 thyroids. In 2006-2007, 9,732 cases were recorded; 622 adrenals, 2,986 parathyroids, and 6,124 thyroids. For 2007–2008, there were 11,587 endocrine operations, to include 676 adrenals, 3,575 parathyroids, and 7,336 thyroids. During the 3 years studied, one fourth (24.7%) of all endocrine operations were performed by an attending surgeon operating alone, without resident or fellow assistance. This includes 17.1% of adrenalectomies, 27.4% of thyroidectomies, and 20.6% of parathyroidectomies (Table I). Specifically, fellows assisted in 6.6% of the total cases, 18.3% of adrenalectomies, 4.7% of thyroidectomies, and 8.2% of parathyroidectomies. The raw numbers for fellow assisted cases were 586 in 2006, 629 in 2007, and 720 in 2008. Senior residents were listed as the assistants in 36.5% of the total cases, 51.7% of adrenalectomies, 34.9% of thyroidectomies, and 36.7% of parathyroidectomies. Finally, junior residents assisted in 30.6% of the total cases, 11.3% of adrenalectomies, 31.3% of thyroidectomies, and 32.9% of parathyroidectomies. In all, 98.2% of thyroid cases 94.7% of parathyroid operations were done by general surgeons, with the remaining performed by ear, nose, and throat (ENT) surgeons.

Operating with residents or fellows did not significantly increase wound infections, medical complications, return to the operating room, or overall morbidity (Table II). This held true after stratifying by surgical procedure and controlling for common risk factors such as age, sex, and obesity. We then asked if residents were systematically operating on sicker patients. Octogenarians ($P = .05$), as well as patients with diabetes ($P = .05$) or obesity ($P = .02$), were significantly more likely to be operated on by attendings operating alone, and patients categorized under severe ASA class (III or IV) had a trend toward significance as well ($P = .07$).

Overall, attending surgeons operating alone had shorter operative times for every type of procedure than attending surgeons assisted by residents or fellows with statistically significant differences for all procedure types (thyroidectomy with modified radical neck dissection did not reach significance) (Table III). This remained a significant predictor after controlling for age, sex, and obesity. However, when attending surgeons operated alone, patients had significantly greater durations of stay for all thyroidectomies (1.73 days vs 1.60 days, $P < .001$) and parathyroidectomies (1.80 days vs 1.65 days, $P = .02$), with adrenalectomy patients showing a trend toward the same result (3.68 days vs 3.19 days $P = .09$) (Table IV). Additionally, for thyroid and parathyroid operations, patients of attending surgeons operating alone were more likely to have a duration of stay greater than 24 h compared to patients whose operations had resident or fellow assistance ($P<.001$). This difference persisted after stratification by operative type.

Because one of the NSQIP recorded variables was “secondary procedure codes,” we examined

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<td><strong>Surgical assistance</strong></td>
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PGY, Postgraduate year.
the usage of both intraoperative ultrasound and nerve monitoring for thyroid and parathyroid operations. Overall, ultrasound use was documented in 2.5% of thyroid procedures, 3.4% of the total cases assisted by residents or fellows, whereas only 0.2% of cases performed by an attending operating alone \( (P < .001) \). Ultrasound use was documented in 4.0% of all parathyroid operations, 4.9% of the cases with resident or fellow assistance, whereas only 1.0% of the cases performed by an attending operating alone \( (P < .001) \). Use of nerve monitoring was recorded in 3.3% of thyroid operations overall; 3.8% with resident or fellow assistance and 2.0% of cases performed by an attending alone \( (P < .001) \). For parathyroid operations, 2.8% overall used nerve monitoring; 3.0% of the operations performed with a resident or fellow, whereas only in 2.1% of operations done by an attending operating alone \( (P < .001) \).
number of endocrine surgery cases while in residency than their peers, more than one third feel unprepared to perform endocrine procedures adequately after graduation.\textsuperscript{15} This sentiment reflects both a 1996 review by Harness et al\textsuperscript{16} as well as a more recent update in 2007 by Le et al\textsuperscript{17} of a continued lack of operative experience by graduating general surgery residents in adrenal, endocrine pancreas, and less common endocrine procedures based on resident submitted surgical operative logs to the Resident Review Committee (RRC), which oversees and credentials all residency programs. Therefore, it seems that endocrine surgery fellowships are vital not only to provide adequate supplementation or “finishing” to ones’ general surgery training, but also to train future leaders in the field of endocrine surgery that foster a high standard of care, research in both clinical and basic science, and a multidisciplinary, collaborative working environment.\textsuperscript{18}

Despite the potential positive aspects of endocrine surgery fellowships, concern has been raised that the growth of such fellowships will detract from the operative endocrine experience of general surgery residents at those institutions. The argument asserts that fellowships result in competition for operative cases, thus perpetuating the cycle of graduates with insufficient experience in endocrine surgery. However, one must also remember that those programs with endocrine surgery fellowships are generally those programs with the highest number of dedicated endocrine surgeons, and therefore, highest case volumes. In addition, these programs account for only a small fraction of all endocrine operations; a large percentage of operations are performed by surgeons whose main focus is NOT endocrine surgery.\textsuperscript{19} In other words, low-volume surgeons are doing most of the thyroid, parathyroid, and adrenal operations in the U.S. and Canada. Increasingly, evidence suggests that even with the addition of newly graduated endocrine fellows to the workforce, future projections are of a sizeable shortage of high-volume endocrine surgeons to meet the endocrine case demands.\textsuperscript{10}

Our data show that fellow-assisted cases continue to make up only a small portion of the total endocrine case volume. Although there are only 15 endocrine surgery fellows and approximately the same number of surgical oncology fellows each year (with only about 80% training at NSQIP reporting hospitals), the percentage of cases in which they are assisting has remained constant over the 3 years of the database we analyzed, which was during the expansion of fellowships. In all, 9/12 fellowship programs were at NSQIP participating hospitals in 2005–2006 and 11/14 programs for 2006–2008. During the time period in question, the NSQIP was only collecting data for general and vascular surgery cases. As shown by our data, most were performed by general surgeons, therefore showing that the database is a reasonable place to examine operating room assistance in the general surgery endocrine cases. For the most part, this is a positive finding from the perspective of endocrine surgery fellowships.

Overall, it seems that general surgery residents are getting the same exposure and training in endocrine surgery as more fellowships are created. Looking at published RRC case logs, over the past 4 years, the total number of endocrine surgery cases logged by general surgery residents has continued to increase.\textsuperscript{19} For example, during the most recent completed academic year, 2008–2009, a total of 35,605 endocrine cases were performed by general surgery residents; 23,251 thyroids, 9,867 parathyroids, 2,320 adrenals, 124 endocrine pancreas, and 43 “other” endocrine operations. This number is up from 2005–2006 when 16,945 endocrine cases were logged, including 11,177 thyroids, 5,004 parathyroids, 697 adrenals, 51 endocrine pancreas, and 16 “other” operations. Even though the RRC’s required number of endocrine surgery cases for chief residents is extremely low (n = 8), chief residents are graduating with an average of 29 endocrine operations, to include 10 during their chief year alone. Given these numbers, those who do go on to practice general surgery in the community should have a basic foundation to perform endocrine operations. We would need to review data from specific general surgery training programs with endocrine fellowships to obtain a more accurate picture of how case volume distribution has changed, if at all, since these programs have started training fellows.

Endocrine surgeons may wonder why almost 25% of endocrine surgery cases are being performed by an attending operating alone. Unfortunately, without specific institutional or surgeon data, a definitive explanation is difficult. It may be that the hospitals with the busiest volume do not have enough resident labor (with the 80-h workweek) to cover all the cases. Some hospitals or surgical departments have hired physician assistants to help high-volume surgeons complete their case load without resident assistance. For example, at our parent institution, Massachusetts General Hospital, a physician assistant is assigned to help our highest volume endocrine surgeon for most of the weekly thyroid and parathyroid surgical cases. Another possibility is that surgeons in private
practice, sometimes even if residents are available, may prefer to have their physician assistants first assist in the operating room. These numbers may also reflect the composition of hospitals participating in the NSQIP, indicating that perhaps a large number of endocrine surgery is performed at community hospitals with no resident or fellow assistance.

The fact that patient morbidity was the same, regardless of the participation of residents or fellows, is not surprising. On a similar note, when stratified by operative type, the 2 operations most likely to be performed by an attending alone were thyroid lobectomy or parathyroid exploration (separate from reexplorations). Interestingly, we did not find that residents were operating on sicker patients, as might be expected at the larger teaching institutions, at least for the factors captured by the NSQIP. Again, as noted previously, the NSQIP is not suited for examining endocrine surgery-specific outcomes such as recurrent laryngeal nerve injury or temporary/permanent hypocalcemia rates. Additionally, although it was not surprising to find that operations were shorter when surgeons operated alone, thereby not taking extra time to teach, it is not clear why their patients had a statistically significant longer duration of stay. This increased duration of hospital stay could relate to issues regarding billing and/or hospital resources. Given that a large variety of hospitals that contribute to the NSQIP database, one pitfall of this database is that we have no access to specific hospital or surgeon data. It is possible that attendings who operate alone also do not have hospital/resident/ancillary staff help during the peak discharge hours and, thus, they may not have the chance to observe and discharge their patients until the end of the day. Practically speaking, a 1-day increase in duration of stay may not seem to be of much clinical significance. However, the fact that the patients of “attendings operating alone” have significantly greater rates of a >24-h duration of stay ($P < .001$) may increase hospital costs/charges, because costs are often associated with per-24-h periods so the “attending operating alone” hospital costs might indeed be greater.

Because the use and proper interpretation of intraoperative ultrasound and nerve monitoring is an important skill that many surgeons who perform endocrine neck operations believe that their colleagues should at least have at their disposal, we thought it would be interesting to observe whether surgeons teaching residents and fellows were more likely to use these tools. This, indeed, was the case. However, one must be careful in accepting these results at face value because the documented overall usage was so low. For example, even though only 2 papers (surveys) attempt to elucidate the usage of nerve monitoring nationwide, one with ENT surgeons mainly in private practice and one with general/endocrine surgeons mainly in academic centers, the reported usage (23–49% and 37.1%, respectively) was still much higher than the 3% to 4% recorded in the NSQIP data.$^{20,21}$

It is important to recognize some inherent limitations of our study. First, although the NSQIP captures a large number of postoperative adverse events, several complications specific to endocrine surgery are not part of the database and, therefore, are not addressed in this analysis, namely hypoparathyroidism and recurrent laryngeal nerve injury. All large database studies have limitations in potential coding and sampling errors as well as limitations in the regression analysis from incompleteness and nondiscrimination (because of rarity of events or sample size). In addition, there is “missing” or “incomplete” data that can be handled by a variety of statistical approaches. Moreover, there is an increased chance for underestimation of comorbidities in both the elderly and outpatients, and the potential subjectivity of certain variables, such as ASA class. We also could not distinguish “low-volume” from “high-volume” surgeons, academic from private practice centers, and the exact “difficulty” of any given operation. We also do not know the exact number of hospitals that have a resident complement assisting in surgical cases. However, we should emphasize that the NSQIP database captures all perioperative complications that occur within 30 days, including those that were not related to the procedure directly, and the rigorous auditing and scrutinizing of the data should minimize many problems inherent to other large databases.

In conclusion, even with the increased number of endocrine surgery fellowships, almost one fourth of all endocrine operations are still performed by attending surgeons operating alone. In addition, the percentage of fellow-assisted cases has not increased during the past few years. Although there was no significant difference in patient outcomes if surgeons operated alone or with residents and fellows, operations were significantly shorter and the surgical duration of stay was longer when attendings operated alone.

American College of Surgeons National Surgical Quality Improvement Program and the hospitals participating in the ACS NSQIP are the source of the data used herein; they have not verified and are not responsible for the statistical validity of the data analysis or the conclusions derived by the authors.
REFERENCES


DISCUSSION

Dr Richard A. Prinz (Chicago, IL): I have some questions or reservations about the data in the sense that to be a NSQIP hospital, you do not have to have a residency program. So how did you deal with that issue? Nor do you have to have an endocrine surgery fellowship. How were you able to drill down to those particular issues? With regard to procedures like adrenalectomy, many of these are done by minimally invasive fellows. Were you able to sort that out in any way? These are important questions, but I do not think they detract very much from your very hard work in trying to get us information.

Dr Melanie Goldfarb (Boston, MA): I will try to address a few of those questions. To answer them as a whole, a lot of those issues are very important. And, unfortunately, we do not have access to that data. We cannot distinguish endocrine surgery fellows from minimally invasive fellows, or surgical oncology fellows, for that matter, but we do know that they are not done by urology or some other subspecialty because the data is just from general surgery.

To answer some of your other questions: Yes, hospitals do not have to have a residency program, nor do they have to have fellows in order to participate in the NSQIP. As I said, we cannot control for that because we cannot get data on specific programs. But, I was able to figure out which endocrine surgery fellowship programs were participating in the NSQIP during the times we studied and then tried to estimate some of that data.

Dr Nancy Perrier (Houston, TX): Melanie, congratulations on a nice project. Do you have any hypothesis as to why the patients stayed in the hospital longer when operated on by attending surgeons only? And do you have more information, was it just that the 24-hour clock sort of ticked past and maybe the surgeons that operated without residents rounded later or the discharge was prolonged? Or, is it merely the 24-hour outpatient stay? Can you give us a reason for that?

Dr Melanie Goldfarb (Boston, MA): Thank you, Dr. Perrier. We addressed some of those questions in our paper. One may ask, “Was our data for length of stay actually clinically significant?” And the answer is, we don’t know. Probably not, since it was only 0.1% of time.

But, I guess when you look at the greater than 24-hour stay, which is another NSQIP variable that you can look at, it could very well end up being clinically significant when you look at reimbursement by insurance.
And, again, we do not know if it is that attendings make rounds later or that residents can discharge patients. I wish that we could look at that data, but we cannot.

**Dr Quan Yang Duh** (San Francisco, CA): Melanie, very nice paper. A very quick question: I thought the NSQIP data does not include outpatients. So did you take that into account? What about these parathyroid cases that are being done and the patient is sent home the same day? Are they included in the data?

**Dr Melanie Goldfarb** (Boston, MA): As far as I know, it is capturing all data of general surgery and vascular cases at the participating institutions, including both inpatients and outpatients for all major cases.