Techniques of parathyroid exploration at North American endocrine surgery fellowship programs: what the next generation is being taught

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Abstract

BACKGROUND: Minimally invasive techniques are now often used to treat primary hyperparathyroidism but with uncertain conformity and some controversy. Endocrine surgery fellowships (ESFPs) have recently proliferated.

METHODS: The directors of the 19 ESFPs recognized by the American Association of Endocrine Surgeons were polled to identify the approaches currently taught to trainees.

RESULTS: With 100% participation, all ESFPs obtain R1 imaging study, and 95% use ultrasound to assess for concurrent thyroid nodules that require care. For an apparent single adenoma, all ESFPs minimize dissection, use intraoperative parathyroid hormone monitoring, and, if multiglandular disease is identified, perform 4-gland exploration. Outpatient surgery (89%) and postoperative oral calcium use (68%) are common. All programs define cure as durable normocalcemia (median, 6 months).

CONCLUSIONS: American Association of Endocrine Surgeons fellowship programs teach congruent management strategies that include focused dissection, intraoperative parathyroid hormone use, and intent to cure. These consistencies define a future standard for assessment of parathyroidectomy outcomes.

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The first successful parathyroidectomy for primary hyperparathyroidism (PH) was performed in 1925. Ever since, surgeons have been challenged to achieve operative cure given the fact that only about 85% of patients with sporadic PH have single parathyroid adenomas, while the rest have multiglandular disease that is often occult on imaging. Thus, the gold standard in the surgical management of PH has long been bilateral cervical exploration, with visual identification of all parathyroid glands, comparison of relative gland sizes and weights, and resection of only enlarged glands. Over the past 2 decades, however, with improvements in preoperative imaging techniques and the development of immunoassays that allow rapid, intraoperative measurement of parathyroid hormone (PTH) levels, the surgical approach to patients with PH has undergone a fundamental and rapid shift.1-5 At most but not all US medical centers, routine bilateral cervical exploration has largely been supplanted by minimally invasive approaches that allow a direct, focused dissection of the
culprit parathyroid glands and that rely on functional assessment with intraoperative PTH (IOPTH) monitoring to determine if all abnormal glands have been removed; IOPTH monitoring can also help with intraoperative localization. When combined with IOPTH monitoring, several minimally invasive approaches have now been shown to have equivalent long-term success rates compared with traditional routine bilateral parathyroid exploration.6–10

In a recent survey of parathyroid surgeons, Greene et al5 found that a limited approach was performed by 68% of survey respondents, compared with only 11% 10 years previously; similarly, routine bilateral exploration was performed by 10% of respondents, compared with 74% only 10 years previously. Yet despite widespread acceptance of the concept of a focused approach as the preferred method, there is considerable variability in knowledge and practice patterns related to technique and to use of adjuncts, a disparity highlighted by recent debate in the surgical literature regarding the best surgical approach.11,12

In 1980, the American Association of Endocrine Surgeons (AAES) was founded as a society devoted to “surgical expertise in diseases of the thyroid, parathyroid, adrenal glands as well as neuroendocrine tumors of the pancreas and GI tract.” Accompanying the rapid growth both in AAES membership and in high-volume endocrine surgery centers nationwide has been the proliferation of new endocrine surgery fellowships; as of 2011, there were 19 clinical fellowships recognized by the AAES in the United States and Canada. The increasing number of trained endocrine surgery fellows likely means wider dissemination of learned techniques for parathyroidectomy. The purpose of this study was to identify the methods of parathyroidectomy for PH that are now being taught to the next generation of endocrine surgeons in these programs.

Methods

A brief clinical survey was constructed by the senior author concerning the routine conduct of parathyroid exploration for sporadic PH. The survey consisted of questions on management ranging from use of preoperative imaging, use of intraoperative adjuncts, and postoperative management of patients with PH. The program directors of the 19 AAES-recognized clinical fellowships in North America at the time of the 2011 annual meeting of the AAES were asked to participate, with the specific assumption that their responses would reflect the philosophy and approach of all faculty endocrine surgeons at their program. All surveys were conducted by a single person (S.E.C.). The study received approval of the institutional review board at the University of Pittsburgh (PRO11050171).

Results

All AAES program directors participated in this survey, for a response rate of 100%. The geographic distribution of the programs is depicted in Fig. 1.

Preoperative vitamin D testing was reported by 84% of programs. All programs obtain ≥1 type of imaging study for localization preoperatively, and all plan to minimize dissection with a focused approach if an apparent solitary adenoma is identified on imaging. Most programs (89%) obtain >1 imaging study for localization, with the most common combination being ultrasound and sestamibi (Fig. 2). Cervical ultrasound is obtained by 18 programs (95%); 7 programs (39%) reported performing their own ultrasound, and 11 programs (61%) reported using radiology-performed ultrasound (P = .10). Sestamibi imaging, with or without single-photon emission computed tomography, is routinely obtained by 15 programs (79%), including 2 programs that obtain combined single-photon emission computed tomographic and computed tomographic scans, and is the sole imaging modality obtained at 1 program (5%). Five programs (26%) reported routinely obtaining 4-dimensional computed tomographic scans for preoperative imaging. Of the 18 programs that routinely obtain ultrasound, all use the information obtained to identify potential thyroid pathology, and if identified, all obtain fine-needle aspiration biopsy as clinically indicated to determine the need for concomitant thyroid surgery at the time of parathyroidectomy.

IOPTH monitoring is used at all 19 training institutions during exploration for PH. Interestingly, respondents reported considerable variation in the assay type and in the institutional turnaround time for results, as well as in the number, sites, and timing of IOPTH samples (Table 1). To define an adequate IOPTH drop after parathyroidectomy, 7 programs (37%) use the sole criterion of a decrease of >50% from the highest preexcision value, while 12 programs (63%) use the dual intraoperative criteria of a decrease of >50% from the highest preexcision value plus a decrease into the normal range for the assay used (P = .10). Several respondents also indicated that a downward-sloping trend in postresection IOPTH levels was a predictor of success. If intraoperative criteria are not met, all programs consider this to signify the presence of additional abnormal parathyroid tissue, and guided by IOPTH results, all continue the operation with intent to find and manage the additional tissue for cure. During exploration, most programs (84%) obtain the weight of the resected abnormal parathyroid glands, but only 2 programs (11%) routinely dissect and identify the ipsilateral normal parathyroid gland (P < .0002), and no program reported routine biopsy of an ipsilateral normal gland at every operation.

In addition to IOPTH criteria, situations named by some respondents to routinely prompt a bilateral exploration included the intraoperative discovery of >1 ipsilateral enlarged gland (42%), an inability to find a culprit gland on the first side (32%), bilaterally positive imaging results (32%), lithium history (11%), an initial low IOPTH level (5%), and very young patient age, which is associated with undiagnosed multiple endocrine neoplasia type 1.13 Without considering a bilateral exploration to be obligatory, 8 programs (42%) reported heightened concern for multiglandular disease if the first encountered abnormal parathyroid
gland is relatively small (reported as median weight < 100 mg; range, 21 to 200 mg), and some other named factors included when the ipsilateral “normal” gland is rounded or globular instead of flat, when the patient is quite elderly, or when the preoperative imaging results are nonlocalizing. Interestingly, the programmatic reported rates of multiglandular parathyroid disease ranged widely, from 3% to 40% (median, 14%). Although the data are self-reported and variable, we observed a possible preponderance of multiglandular disease at northern latitudes (Fig. 3). Endocrine surgery programs at institutions north of 40° of latitude appear to report higher rates of multiglandular parathyroid disease than do more southerly programs (19% vs 8%, P = .008).

With respect to other adjuncts and techniques, during initial parathyroidectomy, 17 programs (89%) do not use

Table 1  Use of intraoperative PTH monitoring (n = 19)

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
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</thead>
<tbody>
<tr>
<td>Routine site of PTH sampling</td>
<td></td>
</tr>
<tr>
<td>Arm, via intravenous catheter</td>
<td>9 (47)</td>
</tr>
<tr>
<td>Arm, via arterial line</td>
<td>2 (11)</td>
</tr>
<tr>
<td>Foot, via intravenous catheter</td>
<td>3 (16)</td>
</tr>
<tr>
<td>Internal jugular vein</td>
<td>4 (21)</td>
</tr>
<tr>
<td>Anterior jugular vein</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Timing of first PTH level</td>
<td></td>
</tr>
<tr>
<td>Preoperative/holding area</td>
<td>3 (16)</td>
</tr>
<tr>
<td>Before induction of anesthesia</td>
<td>4 (21)</td>
</tr>
<tr>
<td>After induction of anesthesia</td>
<td>6 (31)</td>
</tr>
<tr>
<td>At incision</td>
<td>3 (16)</td>
</tr>
<tr>
<td>After incision</td>
<td>2 (11)</td>
</tr>
<tr>
<td>After resection of the abnormal gland</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Timing of postexcision levels</td>
<td></td>
</tr>
<tr>
<td>At time of excision</td>
<td>11 (58)</td>
</tr>
<tr>
<td>5 minutes after excision</td>
<td>14 (74)</td>
</tr>
<tr>
<td>10 minutes after excision</td>
<td>19 (100)</td>
</tr>
</tbody>
</table>

PTH = parathyroid hormone.
the radioguided probe, and 2 programs (11%) routinely use it ($P = .004$). Two programs (11%) use the technique of video-assisted parathyroidectomy in selected patients. Fourteen programs (78%) do not use recurrent laryngeal nerve monitoring during initial parathyroid surgery, while 4 programs (22%) use it routinely; the use of nerve monitoring at 1 program was unreported. Cervical block anesthesia is used variably by 9 programs (47%), with reported use frequencies ranging from 5% to 90%; 9 programs never use this approach, and 1 program reported use of cervical block anesthesia in all patients undergoing parathyroidectomy. Currently, only 2 programs (11%) routinely obtain intraoperative frozen section examination to confirm the identity of resected parathyroid tissue.

After surgery, 17 programs (89%) offer same-day discharge to select patients. Altogether, 8 programs (47%) reported that >90% of patients were able to be discharged on the day of surgery. Upon discharge, 13 programs (68%) routinely prescribe oral calcium supplementation, 3 programs (16%) do not discharge patients on calcium, and 3 programs (16%) selectively prescribe calcium supplements ($P < .001$). Vitamin D supplementation is selectively prescribed after surgery by 11 programs (58%) and routinely prescribed at the time of discharge by 1 program (5%); 7 programs reported that they do not discharge patients on vitamin D supplementation.

After parathyroidectomy, all fellowship training programs define an operative cure as durable normocalcemia. The necessary duration of normocalcemia varied somewhat by program; the majority (15 [79%]) do not count a patient as cured of primary hyperparathyroidism unless serum calcium levels remain normal for ≥6 months postoperatively (median, 6 months; mean, 5.7 ± 2.2 months). Two programs also require normalization of PTH level as a criterion for operative cure. Long-term normocalcemic elevation in PTH was mentioned by several programs as a signal that further follow-up is needed to exclude long-term recurrence.

**Comments**

Although the approach to parathyroidectomy in patients with sporadic PH has in the past 2 decades undergone a major paradigm shift from bilateral cervical exploration to a focused approach in appropriately selected patients, the results of this study reflect a surprisingly high degree of congruence in the techniques currently being taught at North American endocrine surgery fellowship programs. Importantly, all programs routinely obtain preoperative imaging studies, teach that the operation is performed with intent to cure, and use IOPTH monitoring as the primary adjunct to facilitate a minimally invasive dissection. The results also demonstrate that most programs assess vitamin D status at the time of biochemical diagnosis, localize with several imaging studies, obtain ultrasound preoperatively to identify thyroid nodules that may require concurrent management, offer same-day discharge, and do not consider recurrent laryngeal nerve monitoring or radioprobe guidance to have routine value for initial surgery. Most programs defined cure by the presence of durable eucalcemia.

The study had several potential limitations, including those inherent to a survey in which data are self-reported. Although our response rate of 100% excludes nonresponse bias, which is the most common type of bias in survey research, there is always the potential for reported policy and practice to differ. In this study, the respondents were interviewed orally, allowing potential bias or omissions in data recording. In addition, although the practice patterns of individual surgeons at an institution may vary, the study design was based on the assumption that a director’s approach is an accurate representative of the techniques advocated by a
program to its trainees. Notwithstanding these potential flaws, in conducting this study, we were repeatedly impressed with the candor, wisdom, and detail of the expert replies received.

Despite widespread agreement of the overall philosophy of a focused surgical approach when anatomically feasible, there remains variability in the particulars of surgical management among parathyroid surgeons. Five years ago, a study of surgeons from several disciplines, including endocrine surgery, general surgery, and otolaryngology, addressed 5 broad categories: surgeons’ definitions of terminology and philosophy of parathyroid surgery, factors influencing the decision to perform a particular type of parathyroid operation, use of adjunctive tests, self-reported outcomes, and clinical parameters of practice. The authors found that disparate management was common (eg, routine preoperative ultrasound was obtained by only 64% of respondents). Moreover, nearly half of all general surgeons, surgeons in private practice, and low-volume parathyroid surgeons never used IOPTH monitoring even with a limited exploration (ie, did not use any technique that has been validated to identify and treat multiglandular disease for cure). Recently, a high-volume surgical group candidly reported an unacceptably high long-term failure rate in patients managed with a focused approach but without IOPTH monitoring, consequently advocating bilateral exploration in all patients11 and thus renewing expert discussion of the optimal approach, particularly in the training of our future endocrine surgeons.12

Until the early 2000s, specialty training in endocrine surgery existed primarily as apprentice-type fellowships.15 In 2004, under the direction of the Executive Council of the AAES, a fellowship curriculum was developed and formalized on advanced training objectives and content, and in 2007, the AAES sponsored the first fellowship match for 13 endocrine surgery programs. This has now expanded to 19 clinical fellowships, with 22 positions in 2013. Saunders et al16 found that from 1998 to 2000, surgeons whose practice was composed of ≤25% endocrine surgery performed the majority of endocrine procedures nationally but concluded that this was in large part because nonendocrine surgeons outnumbered endocrine surgeons at the time. In a 2007 study of the endocrine surgery workforce, Sosa et al17 reported that graduating general surgery residents were typically performing <30 endocrine procedures during training, compared with an average of 253 endocrine operations performed by endocrine surgery fellows over the same time period. The effects of this increase in the number of trained endocrine surgery fellows with clinical practices devoted to thyroidectomy, parathyroidectomy, adrenalectomy, and neuroendocrine tumors of the pancreas and gastrointestinal tract are likely to include improved patient outcomes,18,19 and the increase also suggests that a larger proportion of endocrine procedures may be now performed by surgeons trained in the subspecialty.20,21

In 2008, the Third International Workshop on Primary Hyperparathyroidism convened experts in endocrinology and surgery to revise prior National Institutes of Health guidelines on the diagnosis, presentation, and management of patients with asymptomatic PH.22,23 With respect to surgical management, Udelsman et al24 concluded that parathyroid surgery is safe, cost effective, and associated with very low morbidity in the hands of experienced surgeons, and the panel further concluded that a minimally invasive approach was as effective as traditional bilateral cervical exploration and that the type of operative procedure and the use of adjuncts were highly surgeon and institution specific. The results of the present study further highlight that at the high-volume centers now training endocrine surgeons, despite remarkable current congruence in the overall approach to parathyroid surgery during a time of change, significant variability remains in some details of surgical conduct. For example, the specifics of IOPTH use might be expected to vary because of differing institutional assay types and turnaround times, but in our study, they also varied as far as the criteria used to determine success. Another example of disparity is the variation in reported rates of multiglandular disease (3% to 40%), which could relate to referral bias or interestingly to geographical variations in vitamin D deficiency by latitude; whether this difference is real, or reflects self-reported opinion, has yet to be determined, but it could well have a significant impact on the training of endocrine surgery fellows with respect to intraoperative decision making and surgical techniques.

Conclusions

With a rising number of general surgery residents applying for endocrine surgery fellowships, a rising number of endocrine surgery–trained fellows in the United States and Canada will be disseminating new techniques of parathyroid surgery, which will likely influence the overall approach to parathyroidectomy nationwide. There does remain variability in surgical technique, suggesting that further development of “best-practice guidelines” may be needed. Given the rapid changes in parathyroid surgery over the past decade, the management techniques taught currently display a remarkable degree of congruence, which may influence the standard for the future assessment of outcomes in patients undergoing parathyroid surgery.

Acknowledgments

References


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