

Intraoperative Parathyroid Hormone Monitoring

Optimal Utilization



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KEYWORDS

- Primary hyperparathyroidism • PTH • Intraoperative PTH monitoring
- Minimally invasive parathyroidectomy

KEY POINTS

- Advances in preoperative localizing studies and surgical adjuncts, such as the introduction of intraoperative parathyroid hormone (IOPTH) monitoring, have shifted the traditional bilateral operative approach for primary hyperparathyroidism to a focused surgery or minimally invasive parathyroidectomy.
- Focused parathyroidectomy guided by IOPTH monitoring makes this procedure safer, less invasive, and highly successful.
- The utilization of IOPTH interpretation criteria can predict operative success, minimize unnecessary bilateral exploration, decrease the likelihood of resecting parathyroid glands that are not hypersecreting, and prevent recurrence.

INTRODUCTION

With an annual incidence of 21.6 per 100,000 persons in the United States,¹ primary hyperparathyroidism (PHPT) is the most common cause of hypercalcemia due to hypersecretion of parathyroid hormone (PTH) from one or more parathyroid glands. The incidence of PHPT is similar in men and women before the age of 45 but peaks in the seventh decade with most cases occurring in women (74%).² With the increasing utilization of calcium screening in the developed world, the clinical profile of PHPT, typically characterized by hypercalcemic symptoms, nephrolithiasis, bone disease, and neuromuscular symptoms, has shifted from symptomatic hyperparathyroidism to one with subtle or no specific symptoms.³ After ruling out other causes of hypercalcemia, the diagnosis of PHPT is made via biochemical confirmation of an inappropriately

Disclosure: The authors have nothing to disclose.

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Surg Oncol Clin N Am 25 (2016) 91–101
<http://dx.doi.org/10.1016/j.soc.2015.08.005>

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normal or elevated serum PTH concentration in the setting of normal renal function. Most patients with PHPT present with a single adenoma (70%–95%), whereas close to 4% have double adenomas, 15% have parathyroid hyperplasia, and very few cases are due to parathyroid carcinoma.⁴

Surgery is the mainstay of treatment for PHPT, resulting in long-term cure and reversal of symptoms. Although medical therapy for secondary hyperparathyroidism is well established, its role in PHPT is limited to refractory disease and nonsurgical candidates.⁵ Bilateral exploration (BE) is the traditional surgical approach, allowing the surgeon to visualize all parathyroid glands and remove one or more grossly enlarged glands. Although this approach has a high cure rate,⁶ most patients with PHPT have one causative lesion, and a unilateral approach is feasible in most cases. The introduction of highly accurate parathyroid imaging techniques, such as sestamibi scintigraphy and high-resolution ultrasonography of the neck, and the implementation of surgical adjuncts such as intraoperative PTH (IOPTH) monitoring have heralded the idea of minimally invasive parathyroidectomy (MIP), with focused neck exploration and excision of only hypersecreting glands.^{7–11} Focused parathyroidectomy has a lower incidence of postoperative hypocalcemia and decreased risk of recurrent nerve damage. By limiting the dissection, a favorable operative field is preserved in the event of reexploration. Focused surgery guided by IOPTH monitoring allows the surgeon to confirm the removal of all hypersecreting parathyroid glands, and to predict operative success and long-term cure from PHPT.

INTRAOPERATIVE PARATHYROID HORMONE: HISTORICAL PERSPECTIVE

Focused parathyroidectomy relies on accurate preoperative localization of all abnormal parathyroid glands; however, many preoperative parathyroid imaging technologies are subject to missing double adenomas, parathyroid hyperplasia, and ectopically located glands. In these cases, focused parathyroidectomy guided by imaging studies alone would fail in a significant subset of patients. To overcome this deficit, in 1988 Nussbaum and colleagues¹² introduced postresection measurement of PTH as an adjunct to show cure. In 1991, Irvin and colleagues¹³ introduced a rapid IOPTH assay to assess adequacy of resection. For the first time, a series of 21 patients had their parathyroid surgery guided by IOPTH using an immunoradiometric method. The short half-life of PTH (2–4 minutes)¹⁴ makes it ideal for intraoperative use. In 1996, this rapid assay method was further developed to an immunochemiluminescence method, and the “quick” IOPTH assay became commercially available for intraoperative use.¹⁵ The assay allowed surgeons to verify resection of hyperfunctioning parathyroid glands with a 15-minute turnaround and, after noting an appropriate decline in serum PTH, the surgeon could forgo visual inspection of the remaining glands. In contrast, a persistently elevated serum PTH prompted further exploration. The use of IOPTH monitoring to confirm cure as a practical adjunct of focused parathyroidectomy has since been validated.^{15–17}

OPERATIVE SUCCESS WITH INTRAOPERATIVE PARATHYROID HORMONE MONITORING

The utilization of IOPTH monitoring to determine the extent of surgery in the setting of PHPT is highly accurate, resulting in excellent outcomes when preoperative localization studies are implemented.^{18–24} Patients with concordant preoperative localization studies represent the easiest to treat group of patients, as image-guided focused surgery results in cure rates exceeding 95% even in operations without IOPTH. When patients undergo focused surgery guided by IOPTH monitoring, this leads to similar or in some cases higher operative success rates ranging from 97% to 99% compared with

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