

Southwestern Surgical Congress

Central venous parathyroid hormone monitoring using a novel, specific anatomic method accurately predicts cure during minimally invasive parathyroidectomy



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KEYWORDS:

Parathyroidectomy;
Intraoperative PTH;
Minimally invasive
surgery

Abstract

BACKGROUND: Measurement of intraoperative parathyroid hormone (PTH) levels is an important adjunct to confirm biochemical cure during parathyroidectomy. The purpose of this study was to evaluate a simplified anatomic technique for PTH sampling from the central veins through the minimally invasive neck incision, and to compare the predictive accuracy of central and peripheral PTH values.

METHODS: A specific anatomic method for central PTH sampling was employed in 48 patients. Samples were drawn simultaneously from peripheral and central veins at baseline and 10 minutes post-excision of all hyperfunctioning parathyroid glands.

RESULTS: The central venous PTH levels independently predicted biochemical cure according to the Miami criterion in all the patients. There was no significant difference in the postexcision central and peripheral values, which were 24.40 ± 1.86 and 21.69 ± 1.74 , respectively ($P = .877$, ANOVA test).

CONCLUSIONS: This study provides the original description of a simplified technique for measurement of intraoperative PTH levels in the central veins with direct comparison to peripheral venous levels, and confirmation of accuracy in predicting biochemical cure when relying on centrally obtained values alone.

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There were no relevant financial relationships or any sources of support in the form of grants, equipment, or drugs.

The authors declare no conflicts of interest.

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Manuscript received March 19, 2016; revised manuscript September 2, 2016

Successful treatment of primary hyperparathyroidism (HPT) requires excision of all hyperfunctioning parathyroid tissue, with the goal of achieving long-term eucalcemia. There have been a series of advances over the past 25 years that have allowed widespread adoption of a “directed” parathyroidectomy that involves less than a bilateral cervical exploration through a small surgical incision. The major advances that underlie this surgical paradigm shift include the availability of more accurate preoperative localizing tests, and the development of quick intraoperative assays for parathyroid hormone (IOPTH) to provide biochemical confirmation that all hyperfunctioning parathyroid tissue has been successfully removed during directed parathyroidectomy.¹ Many feel that the most important adjunct that has made minimally invasive parathyroidectomy feasible and successful has been the point-of-care measurement of PTH levels to confirm biochemical cure in patients that have limited dissection and visualization/resection of selected parathyroid glands during the procedure.

In 1987, Nussbaum et al² described a sensitive 2-site antibody immunoradiometric assay for intact PTH and suggested its potential application in parathyroid surgery.³ Accurate and reliable commercially available quick intraoperative assays for PTH have been available since 1996,⁴ which take advantage of the very short half-life of PTH in the plasma of approximately 3 to 5 minutes.⁵ The ability to obtain results for PTH levels within 8 to 15 minutes provides information that indicates successful resection of the hyperfunctioning parathyroid tissue and protects against operative failures due to missed or overlooked multiglandular disease (MGD) during minimally invasive parathyroidectomy.

We sought to simplify the process of venous sampling for PTH determination. We hypothesized that intraoperative PTH levels drawn with this specific technique are equivalent to values drawn from peripheral IVs, and can accurately and independently predict biochemical cure in patients undergoing minimally invasive parathyroidectomy. The ability to obtain accurate and reliable PTH levels by accessing the central veins through the small operative incision has the potential advantage of obviating the need to place, maintain, and trouble shoot peripheral venous access solely for PTH monitoring. The purpose of this study was to evaluate a simplified anatomic technique for PTH sampling from the central veins through the minimally invasive neck incision, and to compare the predictive accuracy of central and peripheral PTH values.

Methods

Study population

Between July 2014 and February 2016, 48 consecutive minimally invasive parathyroidectomies were performed by a single experienced endocrine surgeon. Clinicopathologic data were collected prospectively and retrospectively

analyzed under an institutional review board–approved research protocol. Patient age, sex, preoperative radiographic and biochemical testing results, operative findings, parathyroid gland size and weight, final pathology, and postoperative biochemical testing results were included. Procedure-related success rate and morbidity were also examined.

Preoperative evaluation

The indications for parathyroidectomy were based on current consensus criteria,⁶ including the presence of serum calcium ≥ 1.0 mg/dL higher than upper limit of normal, significantly decreased bone mineral density, renal impairment, nephrolithiasis, age less than 50 years, or based on patient/surgeon clinical judgment according to individual factors.

Operative procedure

A standardized operative approach was used including neck exploration through a small (3 to 4 cm) low-transverse collar incision. Either regional/local anesthesia with intravenous sedation, or general anesthesia, was used depending on individual patient factors or patient/surgeon preference. A focused (unilateral) approach was employed for patients with preoperative localization of the presumed hyperfunctioning parathyroid gland, and termination of the operation with intended cure was determined by the Miami criterion (PTH decrease of $>50\%$ from the highest either preincision or pre-excision level 10 minutes after parathyroid excision).⁷ The baseline level in the present study was a postincision/pre-excision PTH level obtained from the internal jugular vein with a 22-gauge needle before entering the central neck and with minimal manipulation of in situ parathyroid glands. A specific anatomic approach was employed for central venipuncture through the small incision, by accessing the internal jugular vein between the sternohyoid and sternothyroid muscles at a level cranial to the parathyroid venous drainage (Fig. 1A–C). Venous samples for PTH determination were obtained simultaneously from peripheral and central veins at baseline and 10 minutes postexcision of the adenoma(s).

Postoperative evaluation and follow-up

Patients were seen in follow-up 1 to 2 weeks after parathyroidectomy with measurement of serum calcium and clinical assessment of voice quality, and then 3 to 6 months postoperatively. Persistent HPT was defined as continued hypercalcemia 6 months or less after parathyroidectomy, and recurrent HPT was defined as recurrent hypercalcemia 6 months or more after parathyroidectomy. Permanent postoperative hypocalcemia was defined as total serum calcium less than 8.0 mg/dL or dependence on oral calcium carbonate/calcitriol supplements to prevent symptoms of hypocalcemia.

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