Minimally Invasive Parathyroid Surgery

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Minimally invasive parathyroidectomy offers patients a less morbid surgical approach to treat primary hyperparathyroidism. Biochemically diagnosed hyperparathyroid patients undergo a preoperative sestamibi scan to localize abnormal parathyroid tissue. If the scan is positive, a focused unilateral neck exploration is performed through a 2-3 cm incision with the aid of a gamma detector to identify the radioactive, abnormal parathyroid gland(s).

In the Ochsner Clinic's initial experience with minimally invasive parathyroidectomy, 34 patients were evaluated with 20 positive scans, 4 suggestive scans, and 10 negative scans. Of the 24 patients with scans demonstrating abnormal parathyroid activity, 23 were successfully managed with the minimally invasive technique. The mean total surgical time was 72.9 minutes, and the mean weight of the excised parathyroid glands was 1445.4 mg. All 10 patients with negative scans had a traditional bilateral neck exploration lasting a mean time of 146.5 minutes; the mean weight of the excised parathyroid glands was 388.6 mg. Hypercalcemia was cured in all 24 patients in the positive group and 9 of 10 patients in the negative scan group.

Ochsner's initial experience with minimally invasive parathyroidectomy demonstrates that about 70% of patients can expect to be candidates for this technique, which is associated with excellent cure rates and shorter operative times.

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Once a biochemical diagnosis of hyperparathyroidism is established, surgical treatment has traditionally required a bilateral neck exploration to identify all parathyroid glands and remove those that are enlarged and may be adenomatous or hyperplastic. Hyperplasia is diagnosed when all identified parathyroid glands are enlarged, while adenomas are usually single (although multiple adenomas can occur) but are always associated with at least one normal sized parathyroid gland. In approximately 80-90% of cases, a single enlarged gland is identified (which is consistent with an adenoma) and excised, curing the patient of hyperparathyroidism (1-2). In the 10% of cases associated with multigland disease, the enlarged glands are removed even when four-gland hyperplasia is identified. If four-gland hyperplasia is diagnosed intraoperatively, calcium homeostasis can be reestablished by autotransplanting a portion of a hyperplastic gland into the forearm musculature with a 99% success rate (3-4).

Traditional neck exploration and excision of abnormal parathyroid tissue for hyperparathyroidism is effective, associated with a low morbidity (1-2), and effectively cures 95-99% of patients after a single operation (5). The most common risks are limited to the rare recurrent laryngeal nerve injury or failure to correct the underlying hyperparathyroidism (5). Patients are usually eucalcemic by discharge after a single night's hospital stay and are able to return to their normal activities within 2 weeks of surgery.

Despite the success of the traditional surgical approach to treating parathyroid disease, an alternative approach that minimizes the disability associated with surgery is always desirable.

During the past 10 years, technetium sestamibi has been used to develop a minimally invasive approach that can limit patient discomfort and morbidity. Sestamibi is a lipophilic cation that readily traverses cell membranes and accumulates in mitochondria. Adenomatous parathyroid tissue is associated with a higher metabolic rate and mitochondria content compared with normal parathyroid tissue, and the enhanced uptake of radioactive sestamibi makes the adenomatous tissue identifiable by enhanced imaging (6-8). It has also been demonstrated that parathyroid adenomas lack p-glycoprotein, a membrane transporter best known for its role in the development of chemotherapeutic drug resistance (9). P-glycoprotein actively pumps chemotherapeutic agents and other substances out of the cell, thereby minimizing the intracellular concentration of the substance. P-glycoprotein is evident in the cell membranes of nearly all benign tumors. The absence of p-glycoprotein in parathyroid adenomas may explain the accumulation of sestamibi in this tissue. The recent success of the minimally invasive approach has increased the interest in preoperative sestamibi scanning in all nonfamilial cases of primary hyperparathyroidism.

Methods

At the Ochsner Clinic, the standard outpatient evaluation to diagnose hyperparathyroidism includes a determination of serum calcium, phosphorus, and intact parathyroid hormone levels, and a 24-hour urine specimen evaluation to exclude familial hypocalciuric, hypercalcemia. A thorough history and physical examination are needed to determine if any additional preoperative laboratory or radiographic evaluations are required to ensure that patients are fit for operation. Patients are then offered a traditional neck exploration or a preoperative sestamibi scan that could provide a radio-guided, minimally invasive approach to parathyroidectomy.

Traditional parathyroidectomy at our institution includes identification of four parathyroid glands, both recurrent laryngeal nerves, and a selective parathyroid biopsy policy to histologically document normal parathyroid glands (a biopsy is not performed when only one of the four visualized glands is markedly enlarged). For patients willing to undergo the minimally invasive approach, a preoperative sestamibi scan is performed to localize adenomatous tissue. After a dose of 20-25 mCu of Technetium Tc 99m sestamibi is injected, initial 15-minute views and 2-hour delayed views are obtained in an attempt to localize the parathyroid disease. Patients with equivocal or negative sestamibi scans on the morning of surgery undergo a traditional bilateral neck exploration.

When the sestamibi scan is positive or suggestive of an adenoma, a unilateral dissection is performed under general anesthesia through a 2-3 cm long transverse neck incision about one and a half fingerbreaths above the suprasternal notch between the sternocleidomastoid muscles. The subplatysmal flaps are raised, the strap muscles are divided in the midline, and the thyroid lobe is retracted medially to expose the lateral neck and the parathyroid glands. An intraoperative gamma counter is used to help localize the abnormal parathyroid gland. During our initial experience with the minimally invasive approach, frozen section was performed to confirm the presence of parathyroid tissue in the excised specimen. During the average 10-minute waiting time for pathologic evaluation, the recurrent laryngeal nerve and normal ipsilateral parathyroid gland were usually identified.

After undergoing traditional surgery, patients were admitted to a 23-hour observation unit, and serum calcium was evaluated on the first postoperative morning and at a subsequent outpatient visit approximately 2 weeks after surgery. Patients treated with the minimally invasive technique were discharged the same day as surgery and instructed to call if symptoms of hypocalcemia developed. These patients also returned to the outpatient clinic about 2 weeks postoperatively for a serum calcium level determination. Evaluation for recurrent laryngeal nerve injury was limited to a check of voice quality and, when voice changes were noted, a flexible laryngoscopy was performed selectively.

Results

From December 1998 through January 2000, 34 patients at Ochsner chose the minimally invasive procedure after completing the informed consent process. Of the 34 sestamibi scans obtained, 20 were considered positive for 21 adenomas (the sestamibi scan of one patient demonstrated evidence of a double adenoma). A total of four scans were considered equivocal for adenoma and 10 were considered negative. All 21 adenomas positively identified

by sestamibi were identified at surgery and excised. All 20 patients were determined postoperatively to be eucalcemic. The mean age of the patients with a positive or equivocal scan was 58.3 years. This group demonstrated a mean serum calcium and parathyroid hormone level of 11.4 mg/dL and 135.5 pg/mL, respectively. The mean total operating room time as measured by the anesthesia personnel was 72.9 minutes, and the mean weight of the excised parathyroid glands was 1445.4 mg. A single patient who demonstrated voice fatigue postoperatively recovered completely after 6 weeks.

Four sestamibi scans were considered equivocal; these adenomas were approached with a minimally invasive technique. Adenomas were detected in the indicated location in three cases. In the fourth case, an adenoma was detected in the contralateral neck, which was identified when the operation was converted from a minimally invasive approach to a traditional neck dissection. All four patients have normal serum calcium levels.

The 10 patients with negative sestamibi scans underwent traditional bilateral neck exploration. These 10 patients had a mean age of 64.4 years, mean serum calcium of 11.4 mg/dL, and parathyroid hormone level of 122.0 pg/mL. The mean total operating room time was 146.5 minutes, and mean weight of the excised glands was 388.6 mg. The surgical findings included: a single adenoma in six patients, double adenomas in two patients, four-gland hyperplasia one patient, and four normal-appearing glands which were confirmed by biopsy in one patient. (The latter is the only patient with persistent hypercalcemia in this series and is currently undergoing additional evaluation to localize the source of hyperparathyroidism.)

Discussion

A total of 24 patients (71%) in our series demonstrated a positive or suggestive sestamibi scan preoperatively. In 23 of the 24 cases, the sestamibi findings were confirmed at surgery, and these patients avoided a bilateral neck exploration and hospital stay. Others have also reported a superior ability of sestamibi scans to localize parathyroid disease (10-11). Patients with positive sestamibi scans seem to be similar in age and have similar elevations in their serum calcium and parathyroid hormone levels compared with patients with negative scans. We have observed that patients with positive scans have much larger abnormal parathyroid glands and their operations on average last half as long as patients with negative scans. A positive scan is reliable and enables patients to enjoy the limited morbidity of a minimally invasive unilateral neck exploration. When the scan is negative, the most likely cause of hyperparathyroidism is still a single parathyroid adenoma, which can generally be cured with neck exploration. The effectiveness of parathyroid surgery is illustrated by the fact that 33 of 34 patients in our series were cured of their hypercalcemia by the initial procedure.

Another advantage of using a preoperative localization test like sestamibi is the ability to identify the rare ectopic parathyroid gland high in the neck or chest and avoid a fruitless neck exploration. Although this is an uncommon event and did not occur in our initial experience with sestamibi, avoiding an unsuccessful neck exploration is always desirable.

Others have reported using a minimally invasive technique under local anesthesia when a sestamibi scan is positive (12-13). These same authors have also eliminated frozen section confirmation of the resected parathyroid gland(s) when gamma probe confirms an adenoma. We have not made these changes in our practice to date; however, the use of local anesthesia and the elimination of frozen sections could contribute significant cost savings.

Experienced endocrine surgeons who have historically expressed disdain for preoperative parathyroid localization studies are beginning to change their practices and offer minimally invasive parathyroidectomy (14). Traditional neck exploration for parathyroid disease is safe and effective, but minimally invasive surgery appears to offer the same high quality surgical result with less morbidity. As experience with minimally invasive parathyroidectomy increases, it will likely become the preferred surgical approach to treatment of hyperparathyroidism.

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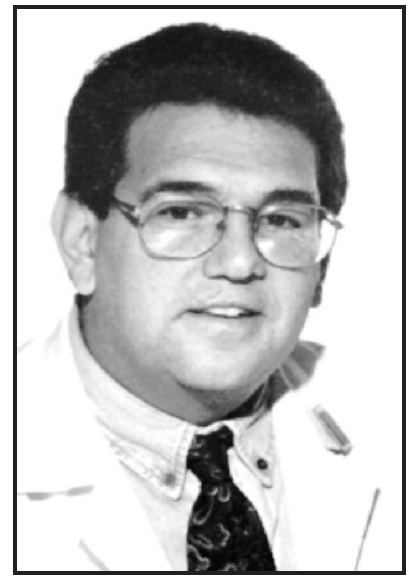

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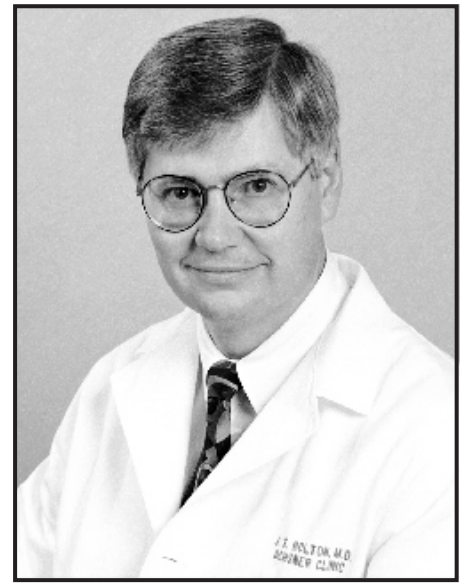

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