Minimal Access Parathyroidectomy Using the Focused Lateral Approach

Technique, Indication, and Results

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Objective: To describe the technique and results of minimal access parathyroidectomy using the focused lateral approach (FLA) under local anesthesia with intravenous sedation for excision of posteriorly located parathyroid glands.

Design: Review of medical records from a prospectively obtained database of patients.

Setting: Tertiary care university hospital.

Patients: The records of 88 consecutive patients who underwent parathyroidectomy via FLA between November 13, 2003, and January 26, 2007, were reviewed.

Main Outcome Measures: The FLA was used when preoperative sestamibi single-photon emission computed tomography or ultrasonography showed an adenoma located superiorly, posteriorly, or retroesophageally. Intraoperative rapid parathyroid hormone assay was used to confirm a single adenoma in all cases.

Results: Eighty cases (91%) were successfully performed under intravenous sedation. In 4 patients, the procedure was converted from a lateral to an anterior approach. Seventy-one patients (81%) were discharged from the hospital the same day. The mean operative times for FLA were 82.6 minutes in the early part of the series and 62.9 minutes in 2006. There were no major complications. One patient experienced transient vocal cord paresis. One patient developed a pneumomediastinum, which resolved without intervention. Another patient developed a small hematoma, which required no treatment and resolved.

Conclusions: The FLA is a safe and effective procedure for excision of parathyroid glands that are located superiorly, posteriorly, or retroesophageally. Its major advantage is the ability to remove glands located deep and posterior through a small incision under intravenous sedation. Although there is a learning curve, the overall operative times for minimally invasive parathyroidectomy decreased after experience was gained. The FLA improves the mean excision time for excision of posteriorly located parathyroid adenomas.

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WITH THE AVAILABILITY of the rapid parathyroid hormone (PTH) assay, the preferred surgical approach to parathyroidectomy is focused single-gland excision rather than bilateral exploration. Most surgeons perform 4-gland exploration only in cases of hyperplasia, secondary hyperparathyroidism, or tertiary hyperparathyroidism. Surgical trends show that more than 90% of parathyroid surgeons are performing focused neck exploration techniques through a midline anterior or lateral approach rather than bilateral exploration. In those who have positive preoperative localization, single-gland excision in conjunction with the rapid intraoperative PTH assay is efficacious, and the rate of recurrence is 0% to 5%. Furthermore, the procedure can be performed as an outpatient through a small incision.

Video available online at www.archoto.com

The terminology and techniques for focused single-gland excision vary. These include minimally invasive video-assisted parathyroidectomy, minimally invasive endoscopic parathyroidectomy, the focused lateral approach (FLA), and the focused anterior approach (FAA). Minimally invasive video-assisted parathyroidectomy is performed through an approximately 2-cm incision using a 5-mm 30° telescope for improved visualization. Minimally invasive endoscopic parathyroidectomy is performed entirely endo-
The medical records of 152 consecutive patients who underwent MIP at our university medical center by the senior attending surgeon (M.S.) between November 13, 2003, and January 26, 2007, were reviewed from a prospectively obtained database. The study and data collection were approved by the university’s institutional review board. All patients had biochemically confirmed primary hyperparathyroidism based on imaging studies that supported the diagnosis of single-gland disease. Patients undergoing parathyroidectomy for secondary or tertiary hyperparathyroidism, or parathyroidectomy in conjunction with thyroidectomy, were excluded because more extensive surgical exploration was performed in such cases. Data analyses revealed that 88 patients underwent FLA between November 13, 2003, and January 26, 2007, which comprised the patient population for this study. The procedure was attempted under local anesthesia with intravenous sedation in all patients undergoing parathyroidectomy via FLA unless the patient specifically wanted general anesthesia. Rapid intraoperative PTH assay testing was used to confirm a single adenoma in all cases. Our postexcision criterion for intraoperative PTH level was a decrease of at least 50% to the normal range.

ANESTHETIC TECHNIQUE

Intravenous sedation was administered by the anesthesia team. Propofol and fentanyl citrate were the most commonly used agents for sedation. In many patients, the procedure was accomplished under conscious sedation; however, some required deep sedation. Supplemental oxygen and standard monitoring were used. Before operative preparation and draping, 1% lidocaine with 1:100,000 epinephrine was infiltrated subcutaneously along the proposed incision. No cervical block was performed. During the procedure, additional local anesthetic was infiltrated in adjacent tissue planes as deeper levels of dissection were reached. If during surgery the decision was made to convert to general anesthesia, the patient was intubated by the anesthesiologist.

PATIENT SELECTION

All patients underwent technetium Tc99m sestamibi scintigraphy with single-photon emission computed tomography (SPECT). Traditional 2-dimensional pinhole scintigraphy images help to identify the presence of an adenomatous gland for a targeted approach. SPECT, especially the sagittal and axial views, assists in determining the depth of the adenoma, which is particularly helpful in detecting glands below the thyroid gland that are deeply located such as a retroesophageal gland. In the latter half of the series, office ultrasonography of the neck was routinely performed to confirm the location of the adenoma for surgical planning and for incision placement (Figure 1). Patients were considered appropriate candidates for FLA when preoperative imaging studies showed an abnormally enlarged parathyroid gland in the following locations: (1) a gland that is posterior to the thyroid lobe, as shown in Figures 2, 3, and 4, and (2) a gland that is located below the inferior thyroid pole but is shown by sagittal view SPECT images to be posterior to a plane along the posterior thyroid (Figure 5) or seen on ultrasonography as deep to the carotid. The FLA was not used for inferior adenomas, which are below the thyroid and are located superficially (ie, anterior to the plane that is marked along the posterior thyroid border). Such glands were excised using FAA.

SURGICAL TECHNIQUE

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METHODS

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the level of the adenoma, starting at the midline and carried to
the anterior border of the SCM (Figure 6) (a video is avail-
able at http://www.archoto.com). This incision is much more
templar than what has been described by other surgeons for the
FLA, which usually extends from the anterior to the posterior
border of the SCM.7,12 The advantage of our more medially based
incision is that it can be easily converted to a standard 6-cm
midline incision for bilateral surgical exploration by extend-
ing the incision to the contralateral side. The incision is car-
rried through the platysma, and limited subplatysmal skin flaps
are elevated. Additional local anesthesia is infiltrated along the
anterior border of the SCM at this time. The anterior border of
the SCM is dissected and retracted laterally, exposing the lat-
eral border of the strap muscles, which is then retracted me-
dially (Figure 7A). If the omohyoid muscle is encountered,
it is retracted inferiorly or superiorly to obtain proper surgical
exposure. The strap muscles and ansa hypoglossi are retracted
medially, and the internal jugular vein is exposed (Figure 7B)
and retracted laterally. Next, the carotid artery is identified
(Figure 7C), dissected along its medial border, and gently re-
tracted laterally. The thyroid capsule is exposed just under the
strap muscles and is retracted medially, allowing direct access
to the posterior aspect of the thyroid gland and tracheoesopha-
geal groove. The parathyroid adenoma is identified (Figure 7D)
and excised.

The typical parathyroid adenoma is not adherent to sur-
rounding tissue and can be easily dissected using a freer elevator.
Small vessels feeding the parathyroid gland are cauterized
using bipolar electrocautery right on the parathyroid capsule
and then divided. Whether the recurrent laryngeal nerve (RLN)
is identified depends on the location of the parathyroid gland.
In general, the RLN courses deep to the parathyroid adenoma,
or well inferior to it in the case of a superior gland. In such cases,
the RLN is not always identified; by using the freer elevator to

Figure 2. Sestamibi early (A) and delayed (B) images of a left superior parathyroid adenoma.

Figure 3. Sestamibi early (A) and delayed (B) images of a left midpole parathyroid adenoma.
bluntly dissect the gland and by not cauterizing or dividing any structure unless one is absolutely certain that it is not a nerve, injury to the RLN can be avoided. If the adenoma cannot be dissected free from the surrounding tissues easily and is somewhat adherent to surrounding tissues, it is better to identify the RLN first before dividing any structures so as to avoid potential nerve injury. When the adenoma is located deep along the lateral or posterior aspect of the esophagus, or deep to the carotid, the RLN may course superficial to the adenoma rather than deep to it. Therefore, with adenomas in these locations, it is better to identify the nerve first and then remove the gland.

Ten minutes after excision of the adenoma, a rapid intraoperative PTH assay is obtained and sent, and the wound is closed. The patient remains in the recovery area without food or beverage by mouth until the 10-minute postexcision intraoperative PTH level decreases to at least 50% of the preexcision level and to the normal range. If the result does not meet these criteria, another assay is obtained. If the second intraoperative PTH reading does not decrease, the patient is returned to the operating room for 4-gland surgical exploration under general anesthesia. Patients are sent home the same day unless the case is converted to bilateral surgical exploration or unexpected clinical circumstances warrant overnight observation.

RESULTS

Of 88 patients who underwent parathyroidectomy via FLA in this series, 23 (26%) were male and 65 (74%) were female. All patients had biochemically confirmed pri-
mary hyperparathyroidism with a single adenoma localized by imaging. In 80 patients (91%), the procedure was completed under intravenous sedation and local anesthesia. Four patients preferred general anesthesia, and 4 procedures (5%) were converted to general anesthesia for bilateral exploration. Seven patients were converted from an FLA to a midline approach by extending the incision to the contralateral side, which allowed for adequate exposure for a standard anterior midline approach. Of those 7 patients, 5 had multiglandular disease.

Operative times were obtained from the operating room records. Surgical start and stop times were available, and the operative times were calculated. Two-sample t test was used to calculate statistical significance. Two-sided significance level of .05 with the Bonferroni adjustment was used. The difference is considered significant if the P value is less than .01. The mean operative times for each year are shown in Figure 8. The overall mean operative time for the 88 patients who underwent FLA was 73.9 minutes. Before the use of FLA in 2004, excision of superiorly or posteriorly located glands was performed using FAA, and the mean operative time was 102.1 minutes (Figure 8). This was statistically significant (P < .001).

When we began using FLA in 2004, the mean operative time for the approach was 82.6 minutes. This gradually improved to 64.4 minutes in 2005 and to 62.9 minutes in 2006.

Seventy-one patients (81%) were discharged the same day, and 17 patients were admitted for overnight observation. A passive drain (small Penrose drain) was placed in 16 patients (18%). The reasons for drain placement included conversion to bilateral exploration, more extensive dissection than anticipated, or medication use that may increase the risk of postoperative bleeding.

There were no major complications. One patient experienced transient vocal cord paresis. One patient developed pneumomediastinum that resolved without intervention. Another patient developed a small hematoma that required no treatment and resolved spontaneously. All patients were normocalcemic at their first postoperative visit.

There are some distinct advantages to performing MIP using FLA under local anesthesia with intravenous sedation. The most notable one is that it allows excision of posterior and deep glands through a 2- to 3-cm inci-

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**Figure 5.** Sestamibi delayed images of a right inferior parathyroid adenoma below the lower pole of the thyroid (A and B); single-photon emission computed tomographic images (C-E), with the sagittal view (D) showing the adenoma located posterior to a vertical plane drawn through the posterior aspect of the thyroid. During surgery, the thyroid was located retroesophageally.
sion under local anesthesia with sedation. If one uses the traditional anterior midline approach for adenomas that are posteriorly or superiorly located, it is somewhat difficult to perform the procedure under local anesthesia, even with intravenous sedation. The reason is that the ipsilateral strap muscle needs to be dissected off the thyroid capsule and retracted laterally, and then the entire thyroid gland has to be rotated and retracted anteromedially (Figure 9A), which is uncomfortable for the patient. The FLA allows a much more direct approach to the posteriorly located parathyroid glands because the ipsilateral strap muscles are left on the thyroid capsule and both are retracted together (Figure 9B). By approaching these posterior glands laterally, coming between the lateral border of the strap muscles and the SCM, one can reach the parathyroid gland easily without a substantial amount of anteromedial retraction on the thyroid and trachea. Although FLA is an excellent technique for minimal access parathyroidectomy, we do not recommend it for every case, as prior reports have advocated.7,8,11 Our opinion differs somewhat from those of previous authors in that we find FLA to be ideal primarily for those glands that are located behind the thyroid or below the

Figure 6. Marked incision for the focused lateral approach (solid line), with proposed extension of the incision (dotted line) should the procedure require conversion to bilateral exploration.

Figure 7. Intraoperative views of the left focused lateral approach. A, The top of photograph is cephalad. The sternocleidomastoid muscle (SCM) is dissected laterally and is separated from the lateral border of the strap muscles. B, The top of the photograph is medial, and the right of the photograph is cephalad. The strap muscles along with the ansa hypoglossi (arrow) are retracted to expose the internal jugular vein (IJ). C, Same view as in B. The carotid artery (C) is exposed. D, Same view as in B and C. The thyroid is retracted medially to expose the parathyroid adenoma (P) located along the posterior thyroid capsule. A video is available at http://www.archoto.com.
thyroid, which are deep. Therefore, positive preoperative localization is an absolute criterion for using this approach. In our opinion, FLA is not ideal for adenomas below the thyroid gland that are superficially located. The midline anterior approach offers a much more direct access to such glands.

The second advantage is that the overall time in the operating room can be reduced using this approach. When we first began to perform MIP under local anesthesia with intravenous sedation in 2004 using the lateral or midline approach, it took longer to perform FLA than FAA (82.6 vs 75.6 minutes). By 2006, the operative times were comparable for the 2 techniques (62.9 vs 58.7 minutes). There is a learning curve with this procedure, as evidenced by our progressively lower operative times in 2004, 2005, and 2006. This is in accord with a previous study by Soon et al,12 which showed that there is a learning curve with minimally invasive procedures; as surgeons become more experienced, patient selection improves, and operative times are reduced. One may argue that, because the operative times are similar between FLA and FAA, there is no notable advantage to using FLA. A comparison of the operative times between FLA and FAA is an unfair analysis because the 2 procedures are used for glands in different locations. The operative time for FAA in our series after 2004 represents excision of superficially located, easily accessible inferior glands, which can usually be quickly removed under local anesthesia. The operative time for FLA represents excision of posteriorly located glands, which are difficult to excise under local anesthesia via FAA and for which many surgeons would use general anesthesia. A more meaningful analysis would be to compare the operative times for excision of posteriorly located glands using FLA vs traditional anterior approach. When this comparison was made, the use of FLA (after 2004) rather than FAA (before 2004) for excision of posteriorly located glands reduced our operative times by 19.5 minutes the first year and by 39.2 minutes the last year, which was statistically significant (P < .001) (Figure 8). Therefore, FLA reduced our operative times for posteriorly and superiorly located glands by providing quick and direct access.

The third advantage of FLA is that a smaller incision can be used for removal of posteriorly located glands, which otherwise would require a larger incision for FAA. Because our incision is mostly medial to the anterior border of the SCM, conversion to bilateral exploration keeps the overall incision size small, requiring only slight extension of the incision to the contralateral side.

The fourth advantage of FLA is the ability to perform the procedure under local anesthesia with intravenous sedation. Most of our patients prefer to avoid general anesthesia, and some patients’ comorbidities place them at high risk for general anesthesia. The level of sedation depends on the patient’s level of anxiety. In some patients, the procedure can be accomplished with light conscious sedation, and some patients require deep sedation. Unlike some prior reports on FLA, we used a combination of only local lidocaine infiltration with epinephrine and did not perform cervical block.3,6,9,10

There are some situations in which it may be infeasible to perform FLA under sedation. A relative contraindication is severe sleep apnea, particularly associated with obesity. Such patients are at risk of oxygen desaturation with deep sedation, and it may be better to perform FLA under general anesthesia. Another situation in which it may be feasible to perform FLA under sedation

Figure 8. The mean operative times of the focused lateral approach by year.

Figure 9. Schematic diagrams showing the routes of access for a right posteriorly located parathyroid adenoma. A, The focused anterior approach, which requires notable retraction of the strap muscles laterally, as well as rotation and retraction of the thyroid lobe medially. Arrow indicates medial retraction of the trachea and thyroid. B, A more direct focused lateral approach to the same parathyroid adenoma with less dissection and retraction. SCM indicates sternocleidomastoid muscle.
is a posteriorly located gland below the sternoclavicular joint. When dissecting these low-lying posterior glands along the paratracheal or retroesophageal space in the superior mediastinum under sedation, there is increased risk of developing pneumomediastinum. The mechanism of this is thought to be that the negative intrathoracic pressure during spontaneous deep inspirations continuously sucks air into the mediastinum and ultimately causes tension pneumothorax. This complication is less likely to occur under general anesthesia. Substantial mediastinal air can be suspected at the end of the procedure if one irrigates the wound and observe air bubbles from the mediastinum as the patient exhales. Should air bubbles be observed, a chest x-ray film should be obtained in the recovery area to rule out a pneumothorax. A small pneumothorax is generally self-limiting; however, a large or symptomatic one may require a chest tube.

CONCLUSIONS

The FLA is a safe and effective procedure for excision of parathyroid glands that are located superiorly, posteriorly, or retroesophageally. Its use is not recommended for superficially located inferior adenomas or for glands that are located in a high location or are well below the sternoclavicular joint. Its major advantage is the ability to remove glands located deep and posterior through a small incision under intravenous sedation. Our modified, more medially based incision can easily be converted to a small midline incision for bilateral explorations should it be necessary. The FLA also reduces operative time for posteriorly located parathyroid adenomas. It can be performed with low complication rates. However, there is a learning curve with this procedure. Nevertheless, after experience is gained, it is a useful procedure that can be added to the armamentarium of the parathyroid surgeon.

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Author Contributions: Drs Shindo and Rosenthal had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Shindo. Acquisition of data: Shindo and Rosenthal. Analysis and interpretation of data: Shindo and Rosenthal. Drafting of the manuscript: Shindo and Rosenthal. Critical revision of the manuscript for important intellectual content: Shindo and Rosenthal. Statistical analysis: Rosenthal. Administrative, technical, and material support: Rosenthal. Study supervision: Shindo.

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REFERENCES