Radioguided Parathyroidectomy

18

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Introduction

Radioguidance has broad applications in parathyroid surgery and should be considered a crucial tool in parathyroid surgeons' armamentariums. Technetium 99m sestamibi, injected the day of surgery, is preferentially retained by parathyroid tissue. This characteristic of parathyroid tissue can be harnessed to facilitate multiple facets of these surgeries, including gland localization, tissue identification, and metabolic assessment. We find that radioguidance is helpful in all parathyroid cases, from minimally invasive to reoperations to bilateral neck explorations.

Selection Criteria and Preoperative Planning

Once the clinical diagnosis of hyperparathyroidism has been made, and the patient is felt to be a surgical candidate, operative planning can commence.

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Those patients with a diagnosis of primary hyperparathyroidism should undergo preoperative imaging in efforts to identify or localize the abnormal gland and allow for a more directed surgical approach when possible. This can be done via ultrasound, technetium 99m sestamibi scanning, or CT, based on institutional resources and imaging quality. It is important to stress that the diagnosis of hyperparathyroidism is a clinical one, and imaging only serves to assist in operative planning. Negative imaging studies do not refute the clinical diagnosis, and surgical intervention should not be delayed. Negative imaging does not prohibit the patient from being a candidate from a radioguided approach.

For those patients with secondary or tertiary hyperparathyroidism, or hyperparathyroidism secondary to MEN, preoperative localization studies are not needed as these generally represent multi-gland disease and hyperplasia.

In patients with persistent or recurrent disease, attempts at re-localization with imaging should be made. This ideally would include cross-sectional imaging (MIBI with SPECT, or CT) to further delineate the area of radioactivity in a three-dimensional setting, especially if initial images were two-dimensional only.

In summary, all patients can potentially benefit from the use of radioguidance during parathyroidectomy, and the only exclusion criteria should be pregnancy and radiation-dose limitations. The use of the low-dose (10 mCi) technetium 99m sestamibi has been shown to be safe for both patients and the operative team.

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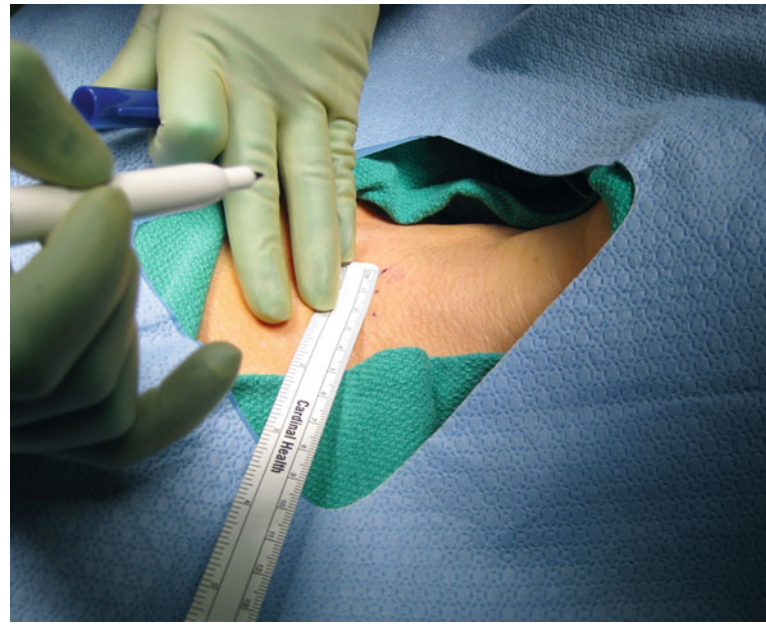

Fig. 18.1 The incision is marked and measured

Procedural Details

Patients undergo an intravenous injection of 10 mCi technetium 99m sestamibi 30 min to 3 h prior to surgery. We generally do not obtain any images on the day of surgery. The day of surgery injection serves to provide signal for intraoperative gamma detection. For those patients who are traveling a great distance to have surgery performed, or who present emergently in hypercalcemic crisis and need intervention done during that admission, a higher dose of 20 mCi technetium 99m sestamibi can be given, with images obtained at 15 and 90 min, and surgery planned within 2–2.5 h of the injection.

Once in the operating room, the patient is positioned. At our institution, we routinely use general anesthesia with either an endotracheal tube or a laryngeal mask. However, the minimally invasive approach can easily be performed under local anesthesia with monitored anesthesia care as well.

After induction of anesthesia, a baseline parathyroid hormone level is drawn from a peripheral vein, generally from the foot. Internal jugular draws are reserved only for those patients with significant peripheral vascular disease and limited access points. They can also be used to help with localization by obtaining samples from the bilateral internal jugular veins.

Surgeon-performed ultrasound can be conducted at this time to verify gland localization and further assist with incision placement.

The patient is then prepped and draped in usual sterile fashion.

We mark out our 2-cm incision mid neck, in a preexisting skin crease (Fig. 18.1). Alternatively, it can be placed directly over the diseased parathyroid if a lateral approach is planned.

Prior to making the incision, a baseline assessment of background radioactivity is measured by placing the gamma probe over the thyroid isthmus (Fig. 18.2). For this procedure, we use an 11-mm collimated gamma probe (Neoprobe 2000, Ethicon Endo-Surgery Breast Care, Cincinnati, OH). A second background count can be obtained by placing the probe over the left shoulder, if preferred.

Once the background number has been obtained, the incision is made. Dissection is carried down through the platysma, and the straps are divided in the midline if using an anterior approach. For the lateral approach the sternocleidomastoid muscle is separated from the strap and omohyoid muscles.

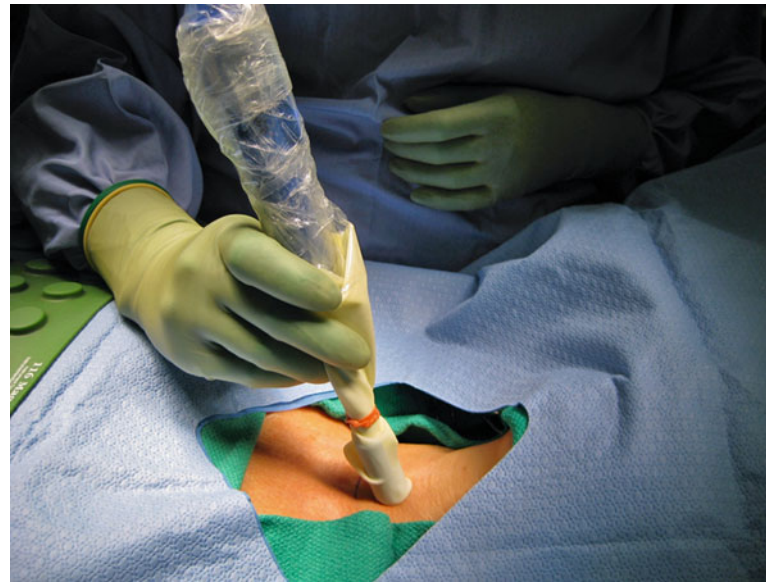

Fig. 18.2 Prior to the incision, the background radioaction count is established with the gamma probe

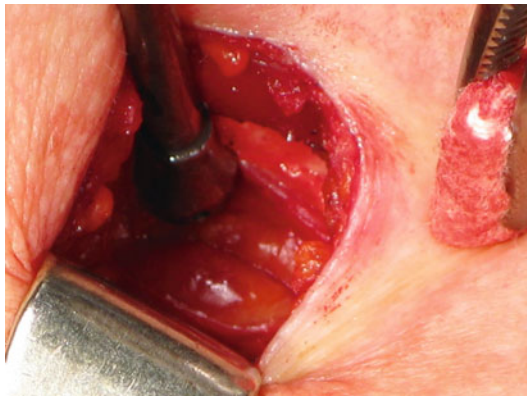

Fig. 18.3 The pathologic gland is identified

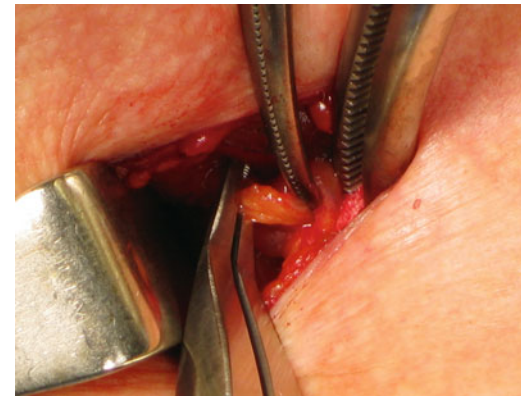

Fig. 18.4 The vascular pedicle of the pathologic gland is isolated and divided

For those patients who do not have any localization on preoperative imaging, radioactivity counts can be taken on both sides of the neck, or more specifically, the four quadrants of the neck. The area of highest activity gives the surgeon an idea as to where to start dissection.

If the gland is not quickly identified during dissection, the gamma probe can be inserted into the wound to provide the surgeon with a trajectory and area of highest activity to further localize ectopic glands.

Glands identified by the surgeon can then be assessed in vivo for radioactivity over that of baseline (Fig. 18.3). If appearing to be consistent with a diseased gland, the vascular pedicle is isolated and controlled (Fig. 18.4). The specimen is then excised, with the timer starting for intraoperative parathyroid hormone monitoring. Ex vivo counts of the excised gland are taken with the tissue balanced on the tip of the probe to ensure no background is picked up from the patient (Fig. 18.5). Counts greater than 20 % of background are thought to represent pathologic parathyroid tissue and confirm the presence of parathyroid tissue within the specimen. Lymph nodes, fat, and normal parathyroid tissue will not have counts this high.

As the gamma probe only helps localize and then confirm the excision of pathologic tissue, we

recommend the concomitant use of intraoperative parathyroid hormone monitoring to confirm that all hyperfunctioning parathyroid tissue has been removed.

Fig. 18.5 After the gland is excised, ex vivo radiation counts are taken. This is done with the gland balanced on the tip of the probe to ensure no background activity is picked up from the patient

Once satisfied that all hyperfunctioning tissue has been excised, hemostasis is meticulously obtained. The wound is then injected with local anesthetic (Fig. 18.6). The strap muscles are then reapproximated, as is the platysma. We use a running, knotless subcuticular closure for the skin (Fig. 18.7a, b). Steri-Strips are then applied.

The majority of patients are able to go home the same day as surgery. Ice packs are routinely used at our institution to minimize tissue swelling and aid in pain control. Oral analgesics are generally all that is needed to achieve adequate pain control. We routinely discharge our patients with oral calcium supplementation. Patients are instructed to take additional doses for any symptoms of hypocalcemia (numbness, tingling, cramping).

Serum calcium and parathyroid hormone levels are checked at the time of the postoperative follow-up visit, occurring 1 week after surgery.

Pearls and Pitfalls

Consistent use of the radioguided technique allows the surgeon to become facile with interpreting the count data. For this reason, we routinely use this approach for all our parathyroid surgeries, and not just the cases with the potential to be more complex.

Fig. 18.6 To minimize postoperative pain the wound is injected with a local anesthetic at the end of the case

Fig. 18.7 (**a**) The wound is closed with a subcuticular closure. (**b**) Completed wound closure

Improper angling of the probe can pick up increased background levels from the heart, carotid arteries, or salivary glands. Thyroid uptake is not always uniform, and can be particularly confounding in patients with nodular thyroid disease. To ensure that the area of increased counts truly represents pathologic parathyroid tissue, the count elevation should exist when holding the probe at multiple angles to the tissue in question.

Glands located in the mediastinum can also be identified with the use of radioguidance and provide the means for a less invasive resection. Those glands localized in the mediastinum on preoperative sestamibi scan can still be accessed via a left video-assessed thoracoscopic approach with the laparoscopic gamma probe assisting with localization. For these patients, this approach offers a less morbid option compared with the traditional median sternotomy.

To ensure best uptake of the tissues, surgery should ideally occur roughly 1 h after injection. The longer after injection, the less sensitive the gamma probe becomes. After 6 h, the gamma probe is less useful. For these reasons, coordination within your medical system is crucial to ensure the patients receive their injections on time and are able to return to the preoperative area without delay. As the gamma probe used for parathyroid surgery is the same machine and

setup used for sentinel lymph node procedures in breast and melanoma surgery, most institutions already have the needed equipment.

Recommended Reading

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