Minimizing Cost and Maximizing Success in the Preoperative Localization Strategy for Primary Hyperparathyroidism

Carmen C. Solorzano, MD[a,*], Denise Carneiro-Pla, MD[b]

KEYWORDS

• Hyperparathyroidism • Parathyroidectomy • Ultrasonography • Localization
• Sestamibi scan • Four-dimensional computed tomography • Cost-effectiveness

KEY POINTS

- Ultrasonography of the thyroid, parathyroid, and soft tissues of the neck should always be performed before parathyroidectomy.
- Ultrasonography performed by an experienced surgeon or radiologist has similar sensitivity to sestamibi scan in localizing eutopic parathyroid adenomas.
- Ultrasonography is the least expensive localization study.
- The most cost-effective localization strategies seem to be ultrasonography followed by four-dimensional computed tomography (4DCT) or ultrasonography followed by sestamibi ± 4DCT. These localization strategies are highly dependent on the quality of imaging (sensitivities are variable).
- Surgeons should critically evaluate the imaging and operative data at their own institution to determine the best preoperative localization strategy before parathyroidectomy.
- Surgeons should communicate with the referring physicians about the best localization algorithms in the local area and become the decision maker as to when to obtain them.

INTRODUCTION

Bilateral neck exploration (BNE) for the treatment of sporadic primary hyperparathyroidism (SPHPT) has a success rate ranging from 94% to 98% when performed by experienced surgeons.[1–3] Minimally invasive parathyroidectomy, with its advantages

[a] Division of Surgical Oncology and Endocrine Surgery, Vanderbilt University Medical Center, 597 PRB, 2220 Pierce Avenue, Nashville, TN 37232, USA; [b] Division of Oncologic and Endocrine Surgery, Medical University of South Carolina, 25 Courtenay Drive, 7008, Charleston, SC 29414, USA
* Corresponding author.
E-mail address: Carmen.solorzano@vanderbilt.edu

Surg Clin N Am 94 (2014) 587–605
http://dx.doi.org/10.1016/j.suc.2014.02.006 **surgical.theclinics.com**
0039-6109/14/$ – see front matter Published by Elsevier Inc.

of smaller incisions, lesser dissection, eligibility for outpatient surgery, and cost savings, has become the preferred surgical approach to SPHPT.[3] To allow a focused dissection and maintain the same success rate as the gold standard operation, minimally invasive parathyroidectomy has required advances in preoperative imaging and development of intraoperative adjuncts.

Although imaging studies guide the surgeon to the precise location of the abnormal parathyroid gland, intraoperative parathyroid hormone monitoring (IPM) assures the surgeon that all the hyperfunctioning tissue has been removed before the patient leaves the operating room.[4] Localization studies should not be used to diagnose hyperparathyroidism or to indicate operative intervention. Rather, once the patient has a secure biochemical diagnosis, the surgeon depends on accurate localization solely to allow a focused approach. Most experienced endocrine surgeons are proponents of localization studies, with the most commonly used method being a combination of ultrasonography (US) and technetium 99m (Tc 99m) sestamibi scintigraphy (MIBI). Four-dimensional computed tomography (4DCT) is usually reserved for reoperative cases; however, some surgeons are now using this methodology as the primary localization study. This review focuses on the most commonly used localization studies in SPHPT (US, MIBI, and 4DCT) and emphasizes their clinical effectiveness and cost-effectiveness.

Parathyroid Embryology and Anatomy As It Relates to Imaging Interpretation

Ideally, the reporting radiologist and the operating surgeon should have a thorough understanding of parathyroid embryology and anatomy. Most patients have 4 parathyroid glands (2 superior and 2 inferior), although supernumerary glands can be encountered in 2% to 13% of cases.[5,6] Understanding the eutopic and ectopic locations of the parathyroid glands is of utmost importance in the interpretation of imaging studies as they relate to the surgical procedure. The surgeon should always review the radiologic images when planning the operative approach and never rely on the radiology report alone. The superior glands are derived from the fourth branchial pouch along with the lateral lobes of the thyroid. The inferior glands arise from the third pouch along with the thymus.

Superior parathyroid anatomic and imaging location

The superior parathyroids are usually located in a posterior plane when compared with the inferior glands. The possible location of the superior parathyroid is posterior to the midportion of the superior thyroid lobe near the crycothyroid junction (>90%), posterior to the midthyroid lobe (4%), superior to the thyroid lobe (3%), in the retropharyngeal/retroesophageal location (1%), or intrathyroidal (0.2%).[5–7] A superior gland that has fallen down because of growth and gravity into the tracheoesophageal groove or paraesophageal area can be imaged in a relatively low cervical location.[8] The inexperienced radiologist or surgeon may interpret this finding as an inferior gland when it is an ectopic superior gland low in the neck.[9] One of the most common locations of a missed parathyroid during a previous failed parathyroidectomy is a superior gland in the posterior and low paraesophageal area.[10] The posterior location of the superior gland can be confirmed on US, CT or single-photon emission computed tomography (SPECT) MIBI images, or the oblique images of a planar MIBI scan. A retropharyngeal/retroesophageal superior gland may not be apparent on US, and 4DCT and MIBI with SPECT or MIBI-SPECT/CT are more suitable to image such posterior locations. An intrathyroidal parathyroid gland can be localized with MIBI scans; however, US is ideal in assisting the surgeon to determine if the abnormality is parathyroid tissue (**Fig. 1**).