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Surgical exploration for hyperparathyroidism

Shivani Shah-Becker, MD, David Goldenberg, MD

From the Division of Otolaryngology—Head and Neck Surgery, Department of Surgery, The Pennsylvania State University, Milton S. Hershey Medical Center, Hershey, Pennsylvania

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Traditionally, primary hyperparathyroidism has been managed surgically with 4-gland exploration. Surgical exploration remains the gold standard in parathyroid surgery and remains an important surgical technique despite the popularity of minimally invasive parathyroid surgery. In this article, we describe the indications, technique, and other perioperative considerations in bilateral parathyroid exploration.

Introduction

Since the 1990s, there has been a paradigm shift in parathyroid surgery. Bilateral exploration has been, in many circumstances, replaced by limited exploration, image guided, radio guided, and endoscopic procedures in the management of primary hyperparathyroidism. In the right circumstances, these procedures offer similar cure rates, shorter operative times, and the potential for fewer complications.[1-3] Despite this, as is the case with all minimally invasive procedures, the knowledge and ability to perform an open procedure is still essential to the successful surgeon. Bilateral parathyroid exploration and identification of all 4 parathyroid glands remains the gold standard in surgical management of primary hyperparathyroidism[2] and an important tool in a parathyroid surgeons armamentarium.

Indications

In primary hyperparathyroidism, more than 85% of patents would have a single adenoma. However, approximately 10% are because of either double adenomas or multigland disease.[4] For those patients in whom more than 1 gland is suspected to be abnormal, bilateral parathyroid exploration is indicated.[2] Preoperatively, the diagnosis of multiglandular disease is challenging, but may be suggested by lower than expected calcium and parathyroid hormone (PTH) levels. Certain imaging characteristics, such as smaller lesion size with less variability between glands, may also be predictive of multi-glandular disease.[5] Certain conditions are associated with multiglandular disease rather than single gland disease, including multiple endocrine neoplasia types 1 and 2a, familial hyperparathyroidism, and lithium-induced hyperparathyroidism. In patients with these disorders, bilateral exploration is warranted.[2]

In patients who have preoperative imaging, that is, discordant or does not localize at all, bilateral parathyroid exploration is recommended. Some studies have suggested that bilateral explorations may actually have shorter operative times in these cases.[6] In this population, the risk of multiglandular disease can be as high as 25%.[7]

Up to 20% of parathyroid surgeries that were initially planned to be minimally invasive will ultimately be converted to 4-gland exploration. Most commonly, this occurs when intraoperative PTH levels do not decrease appropriately after excision of the suspected abnormal tissue. In other circumstances, if the localization appears to

Address reprint requests and correspondence: David Goldenberg, MD, Division of Otolaryngology—Head and Neck Surgery, Department of Surgery, The Pennsylvania State University, Milton S. Hershey Medical Center, 500 University Dr, P.O. Box 850 H091, Hershey, PA 17033.
E-mail address: dgoldenberg@hmc.psu.edu

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be incorrect, or there is evidence of additional diseased glands, then conversion to a bilateral exploration may be warranted.[8]

Anatomy and embryology

Understanding the anatomy and embryological movement of the parathyroid glands is essential to performing a bilateral parathyroid exploration. The majority of humans (~85%) have 4 parathyroid glands.[4] A small subset of the population will have 5 or more glands, and even fewer will have only 3 glands. The glands are each approximately 3-8 mm in size normally and ovoid in shape. The color helps to distinguish the glands from surrounding fat and is typically a darker yellow or caramel to reddish brown color.[9]

Early in development, at about the fifth week gestation, the superior parathyroid glands arise from the fourth branchial pouch and begin to migrate with the thyroid to their final location near the superior pole of the thyroid. At around the same time, the inferior parathyroid glands arise from the third branchial pouch and migrate with the thymus caudally past the superior glands to their location at the lower pole of the thyroid gland.

Disruption in this migration can lead any of the parathyroid glands to reside in ectopic locations. The superior glands vary less in location, and can typically be found about 1 cm from where the recurrent laryngeal nerve (RLN) and inferior thyroid artery cross. Less commonly, they may be found in the posterior neck, retropharyngeal, retroesophageal, or within the thyroid gland itself. The inferior glands are significantly more variable in their location because of their longer descent, and can be found nearly anywhere on the migratory pathway and including the superior mediastinum.

The blood supply to both the superior and inferior parathyroid glands is based on the inferior thyroid artery about 80% of the time. Venous drainage is similar to the thyroid via the complex of superior, middle, and inferior thyroid veins.[9]

The relationship of the RLN to the parathyroid glands is important in parathyroid exploration. The RLN enters the base of the neck after looping around either the subclavian artery on the right side or the aortic arch on the left. The left RLN travels superiorly within the tracheaesophageal groove until it enters the larynx near the cricothyroid joint. The right RLN is located more laterally and does not approach the tracheaesophageal groove until approaching the cricothyroid joint.[9] In close to 90% of cases, the superior parathyroid gland is within 1-5 mm of the RLN, typically posterior and lateral to it.[10] On the other hand, the inferior parathyroid gland is typically anterior and less intimately associated with the RLN.

Technique

The patient is brought into the operating room and placed supine on the operating table. General anesthesia is induced by the anesthesiologist, being careful to avoid nondepolarizing neuromuscular blocking agents. If intraoperative neuromonitoring is used, intubation is performed using an oral endotracheal tube equipped with neuromonitoring electrodes for continuous RLN monitoring during the case. A shoulder roll is placed to achieve neck extension and to appreciate palpable cervical landmarks. Eye pads or goggles are used to protect the patient's eyes.

A curvilinear incision is designed approximately 2 finger-breadths above the sternal notch, centered over the midline of the neck (between the medial borders of the sternocleidomastoid [SCM] muscles). Alignment with naturally occurring skin creases, when possible, can be used to improve postoperative cosmesis. A small quantity of 1%

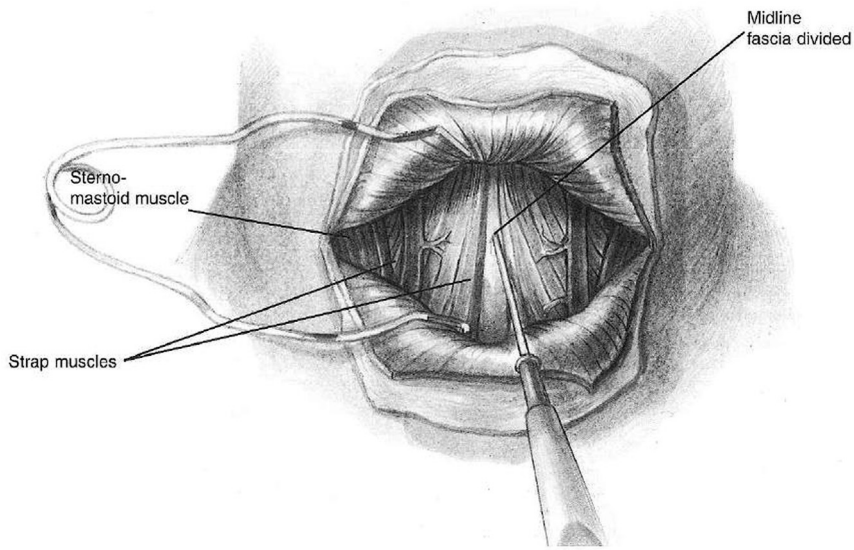

Figure 1 Following the elevation of superior and inferior subplatysmal flaps, the strap muscles are divided in the midline. (Reprinted with permission from Elsevier.[20])