Parathyroid Surgery

Fundamental and Advanced Concepts

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Foreword

Primary hyperparathyroidism is one of the most interesting and extensively studied endocrinopathies, and one of the most successfully treated diseases. In my career of over four decades, primary hyperparathyroidism has gone from a fairly rare to a common disease. The "best of surgical technique" evolved from a bilateral 4-gland exploration with no preoperative localization to subtotal parathyroidectomy on all patients, to removal of an adenoma with biopsy of all other glands, to removal of the adenoma with no other biopsies, to unilateral parathyroidectomy with biopsy or analysis of the second ipsilateral parathyroid, to sparing use of ultrasound, thallium technetium scans, and later Tc-99m-sestamibi scanning, to "mandatory" use of preoperative localization testing and minimally invasive parathyroidectomies of various types. With a conventional bilateral operation and an experienced parathyroid surgeon, cures were obtained in at least 95% of patients. Interestingly today with modern parathyroidectomy techniques, cure rates remain at about 95% or better in the best of series. The last few percent of cures have proved elusive, however, even for experts. Thus, despite numerous advances in this field, many controversies and questions still arise.

Parathyroid Surgery: Fundamental and Advanced Concepts is a well thought-out, comprehensive book which answers many of these present-day questions. It will be of great interest and value to a variety of readers from medical students to the most experienced medical and surgical practitioners. It provides a very comprehensive analysis of the "state of the art" of parathyroid disease in 2014. The editors have linked together contributions by expert endocrinologists, otolaryngologists, and general and endocrine surgeons from Australia, Canada, Europe, and the United States. They discuss the best diagnostic and treatment practices available. I am impressed by the extensive analyses of modern localization techniques and by the wide spectrum of parathyroid operations that are discussed by different authorities. These range from conventional 4-gland exploration to various techniques of minimally invasive parathyroidectomy including radioguided, endoscopic, video-assisted, and even robotic parathyroidectomy, with or without using measurement of intraoperative parathyroid hormone. Straightforward operations to the most complex reoperations are discussed, as are ways to prevent and treat complications of these procedures.

I especially enjoyed the chapter on "The Future of Parathyroid Surgery," written by Shen and Clark. I agree with their problem list and prognostications. Questions for future study, incorporating many of their ideas, include:

- Should parathyroidectomy for primary hyperparathyroidism be used more selectively or more frequently?
- What is a parathyroid adenoma and how does it differ from a normal or hyperplastic gland on genomic or proteomic studies?
- Can localization studies be improved in the future?
- Is it possible to improve the success of parathyroidectomy with lower costs, greater patient safety, and acceptability for most surgeons' practices?
- Will minimally invasive parathyroidectomy be as effective as conventional parathyroidectomy when large series of patients are followed with long-term studies?
- What is the best way to cure the severe parathyroid hyperplasia of MEN1 syndrome? Are other genetic parathyroid diseases present which have not been identified?
- Why does a parathyroid gland become malignant? Can better ways of treating metastatic disease be found?
- Can more effective strategies for prevention and treatment of secondary hyperparathyroidism be discovered?
- Finally, might different types of nonoperative or percutaneous ablative techniques be used and will there be a time when primary or secondary

hyperparathyroidism is prevented or cured by genetic manipulation or medication?

In summary, *Parathyroid Surgery: Fundamental and Advanced Concepts* is an excellent and very valuable book that offers a comprehensive account of our state of knowledge about parathyroid disorders in 2014. Many questions have been answered and other excellent ones have been posed. I recommend this book very highly to all "students" of parathyroid disease.

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Minimally Invasive Parathyroidectomy: North American Modifications

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INTRODUCTION

Parathyroid surgery has witnessed significant change in the last two decades, driven largely by improvements in preoperative localization modalities and intraoperative adjuncts such as the rapid parathyroid hormone (PTH) assay. Perhaps the most significant advancement, however, has been the paradigm shift from the classical bilateral neck exploration, with identification of all 4 parathyroid glands, to the concept of a focused, minimally invasive parathyroidectomy. This transition was initiated by Gagner's[1] report of a completely endoscopic parathyroidectomy, and further developed and popularized by Miccoli et al[2] as the minimally invasive video-assisted parathyroidectomy (MIVAP) procedure. As acceptance of these techniques spread internationally, other surgeons began to modify these procedures and expand their indications. Today, minimally invasive parathyroid surgery may be performed with or without endoscopic assistance, and minimally invasive principles may be utilized even in the setting of nonlocalizing or discordant preoperative imaging.

SURGICAL PRINCIPLES

Regardless of the individual approach used, all minimally invasive parathyroid procedures adhere to several surgical principles. First, these techniques are characterized by incisions that are significantly smaller than the large Kocher incision associated with traditional parathyroid surgery.[3] Using endoscopic assistance, most authors are now able to successfully treat patients through incisions measuring 1.5 to 3 cm.[4,5] Second, the extent of dissection is usually limited to the central neck quadrant suspected of harboring the abnormal parathyroid gland. This highly targeted exploration relies on colocalizing preoperative ultrasound and sestamibi results, as was originally described in Italy and other European countries.[4–6] It is possible to perform a bilateral exploration utilizing minimally invasive principles with a small anterior cervical incision, however, even in the setting of discordant or nonlocalizing imaging studies. Additional principles of minimally invasive parathyroid surgery include wound closure without the use of indwelling drains and rapid discharge from the hospital, though the exact length of stay may vary by country or surgeon.

The most common minimally invasive parathyroidectomy technique incorporates endoscopic assistance to find and remove the offending parathyroid glands. Originally described using CO_2 insufflation,[1] this is now generally accomplished with specialized retraction of the paratracheal space.[5] While the details of this technique have been previously described in this text, the procedure has undergone several modifications as it has been more widely implemented in North American practices. These modifications include preoperative upright incision planning, performance of a cervical ultrasound once the patient is positioned on the operating room table (but before the incision is made), the use of a secondary monitor to improve endoscopic visualization by the operating team, alterations in the timing of intraoperative PTH assessment, same-day hospital discharge, and the routine use of postoperative calcium supplementation.

SURGICAL TECHNIQUE

Nonendoscopic

The planned cervical incision site is marked while the patient is awake and sitting upright in the preoperative holding area. This helps ensure the final scar will be concealed within a naturally occurring skin crease (Figure 13–1).[7] The patient is placed supine on the operating table. Generally, no shoulder roll is required, but lowering the head rest of the bed slightly provides gentle neck extension.

General anesthesia is induced. The patient is intubated with a standard endotracheal tube, though in selected or revision cases a laryngeal EMG endotracheal tube (Medtronic ENT, Jacksonville, FL) may be preferred. Unlike in some European centers,[5] the operating table is then rotated 180° so the patient's lower extremities are facing the anesthesia team. This maneuver not only allows the anesthesia provider to obtain an IV access point in one of the patient's feet for intraoperative PTH assessment, but also clears the operating space for the surgical team and additional equipment such as a second video monitor (Figure 13–2).

Also different from some European practices, an ultrasound is repeated by the surgeon once the patient is in the final surgical position. This confirms the findings of the preoperative studies and helps guide the anticipated dissection. The planned inci-

Figure 13–1. The planned cervical incision site is marked while the patient is awake and sitting upright in the preoperative holding area. (Reprinted from Terris DJ. Novel surgical maneuvers in modern thyroid surgery. *Operative Techniques in Otolaryngology*. 2009;20(1):23–28. With permission from Elsevier.)

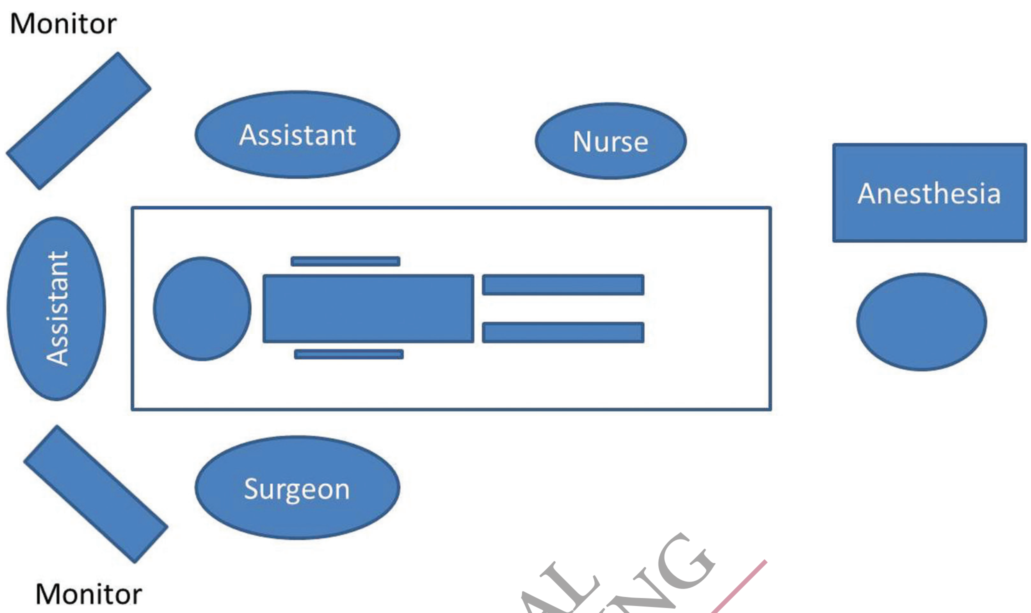

Figure 13–2. The operating table is rotated 180° so the patient's lower extremities are facing the anesthesia team.

sion site is infiltrated with 0.25% bupivacaine with 1:200,000 epinephrine (Hospira, Lake Forest, IL) and the neck is sterilely prepared. No protective skin barrier is applied. A baseline PTH level is drawn prior to incision. When possible, the PTH assay is performed by a technician with mobile equipment in the operating room (Future Diagnostics, The Netherlands), eliminating the transport time required to send the sample to the main laboratory (Figure 13–3).

A 1.5 to 2.5 cm skin incision is made with a knife, and the dissection is carried through the subcutaneous tissue. Absolute hemostasis is essential, as any bleeding from superficial tissue layers can obscure the critical visualization of deeper structural details. The platysma, if encountered, is divided to the lateral extent of the incision, but no subplatysmal flaps are elevated. The strap muscles are separated vertically in the midline to reveal the thyroid isthmus. The strap muscles on the side ipsilateral to the suspected adenoma are bluntly elevated off the thyroid lobe and secured under a Terris thyroid retractor (Medtronic ENT, Jacksonville, FL) (Figure 13–4). No CO_2 insufflation is required. Attention is then directed toward the most likely location of the pathologic gland, as predicted by preoperative localization studies.

Exploration of the superior gland is facilitated by gently retracting the thyroid lobe ventrally and medially, revealing the posterior aspect of the thyroid lobe and the paratracheal region. Though this dissection is usually accomplished without division of the middle thyroid vein, occasionally this vein or the superior vascular pedicle of the thyroid will require transection to fully expose the gland. The inferior parathyroid gland may be found by gently dissecting the soft tissue ventral to the inferior pole of the thyroid gland or may be identified dorsal to the thyroid by gentle retraction of the thyroid lobe. Due to embryologic migration, the superior parathyroid gland lies dorsal to the recurrent laryngeal nerve, whereas the inferior parathyroid gland is ventral to the nerve.

The surgeon's ability to distinguish a normal from abnormal gland visually is crucial to minimally invasive parathyroid surgery, as there are often no normal glands exposed for reference. Normal parathyroid glands are typically flat, exhibit a light brown to tobacco color, and measure 3 to 8 mm in length, with an average weight of 40 mg.[8,9] They are usually surrounded by or capped with fat. Parathyroid adenomas are typically larger, more rounded,

Figure 13–3. Mobile equipment for performing the PTH assay in the operating room.

Figure 13–4. Terris Thyroid Retractor.

rubbery, and a dark mahogany in color. Gentle dissection through any overlying fat may help reveal the enlarged glands. The recurrent laryngeal nerve may be identified and is preserved during this dissection. Once the abnormal gland is identified, blunt dissection with spatulas is used to gently liberate it from the surrounding soft tissue until only the vascular pedicle remains attached to the gland. Soft tissue or fat adherent to the capsule of the gland may be grasped to facilitate retraction and dissection, but excessive manipulation of the gland itself should be avoided, as this may stimulate release of stored parathyroid hormone and alter subsequent PTH levels.[10,11]

Once free from the surrounding tissue, the vascular pedicle supplying the adenoma may be transected with electrocautery or ligated with vessel clips and sharply divided, if it is near the recurrent laryngeal nerve. Frozen sections are not generally required. The surgical field is irrigated, hemostasis assured, and half a sheet of Surgicel (Ethicon, Inc., Somerville, NJ) is placed into the wound bed. The strap muscles are reapproximated in the midline with a single 3-0 Vicryl (Ethicon, Inc., Somerville, NJ) figure 8 suture. The subcutaneous tissue is closed with buried interrupted 4-0 Vicryl sutures and the skin edges are sealed with Derma+Flex® Adhesive™

(Chemence Medical Products, Inc., Alpharetta, GA) and a single transverse Steri-Strip (3M Corporation, St. Paul, MN). No drains or external sutures are required. Deep extubation is performed whenever possible to limit coughing or bucking that can result from anesthesia emergence with an endotracheal tube in place.

Video-Assisted Parathyroidectomy

The completely endoscopic parathyroidectomy originally reported by Gagner[1] has largely been replaced by variations of the MIVAP described by Miccoli.[5] Miccoli originally used CO_2 insufflation to assist with dissection and reported the use of a secondary lateral access site, if necessary, to facilitate gland removal.[2,6] This technique has evolved considerably and is now performed without CO_2 insufflation or a second incision site.[5] The procedure in its current form is identical to that described above, except that after elevation of the strap muscles and retraction of the thyroid lobe a 5 mm 30° endoscope is introduced through the incision, and identification and extirpation of the offending gland is performed with endoscopic assistance.

Even though use of the endoscope offers the surgeon superb visualization of the operative field, one of the limitations of this technique is the need for two surgical assistants. One assistant maintains the operative space with retractors, while another operates the camera. Rotating the head of the bed 180° permits the use of a secondary monitor placed behind the primary surgeon. This second monitor provides the assistants a better view of the operation, decreasing their ergonomic strain and making them better able to anticipate and respond to the needs of the primary surgeon (Figure 13–5).

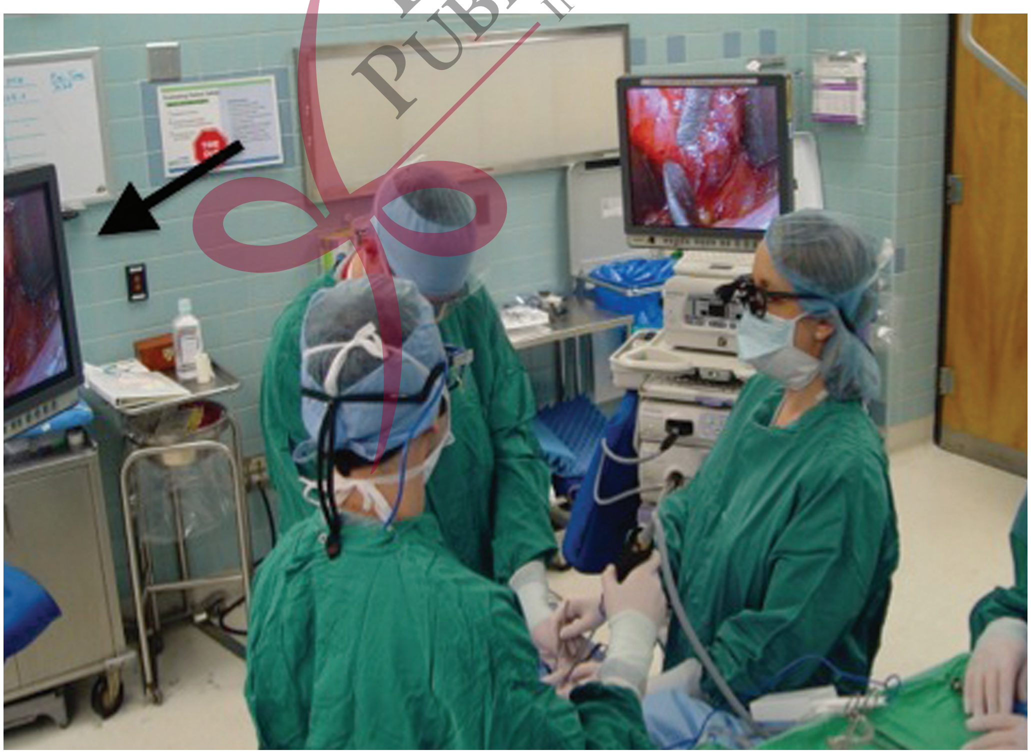

Figure 13–5. A secondary monitor (*black arrow*) affords the entire surgical team an ergonomic view of the operation. (Reprinted from Terris DJ and Seybt MW. Modifications of Miccoli minimally invasive thyroidectomy for the low-volume surgeon. *American Journal of Otolaryngol Head Neck Surg.* 2011;32:392–397. With permission from Elsevier.)