Radio-Guided Parathyroid Surgery

Yoav P. Talmi MD FACS

Department of Otolaryngology, Head and Neck Surgery, Sheba Medical Center, Tel Hashomer, Israel
Affiliated to Sackler Faculty of Medicine, Tel Aviv University, Ramat Aviv, Israel

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Parathyroid surgery has greatly evolved in the past decades. Progress has been relentlessly pursued since Felix Mandl's classic operation on Albert Gahne in 1926, and the successful, albeit seventh procedure for removal of a mediastinal adenoma from Captain Charles Martell by Churchill and Cope somewhat later.

This evolution or perhaps even revolution was multistaged and was influenced by a myriad of factors. The increase in the number of cases of primary hyperparathyroidism identified in the mid 1960s led to a consequential increase in the number of procedures performed. This in turn led to the search for improvement in both preoperative assessment and localization of the diseased gland(s) and to development of less invasive and less costly procedures. Minimizing complications was also a significant driving factor.

In the early 1970s, many surgeons considered subtotal parathyroidectomy mandatory since all patients were believed to have multiglandular disease. Other surgeons, however, had considerable success with bilateral neck explorations, removing the adenoma and obtaining biopsy specimens of all other glands. In time, this evolved to removal of the adenoma with biopsy of only one gland, with subsequent reduced incidence of transient hypocalcemia. Later on, many surgeons performed bilateral neck exploration, removed the adenoma, and only observed the other parathyroid glands without biopsy, still maintaining success rates in the range of 97–98%.

The difficulties in localization of the gland and its removal free of complications led to the following statements epitomizing these issues: "The only localization study in a patient with untreated hyperparathyroidism is to localize an experienced parathyroid surgeon," and "The ectopic position of the gland is when you can't find it; the normal position is when you can."

Recent advances in technology and imaging of the parathyroid glands further led to innovative approaches to parathyroid surgery. The introduction of the rapid or "quick" assay for parathormone allows it to be measured intraoperatively with a short turnover time. A decrease in the PTH concentration of 50% or more from the baseline value correlated well with a cure of the hyperparathyroid state. This allows confirmation of adenoma removal but, obviously, so does frozen section pathologic assessment. The crux of utilization of this assay is that it also confirms the absence of another adenoma or hyperplasia, thus permitting a more limited and less time-consuming procedure.

Another advance in surgery of the parathyroid glands has been the development of improved localization tests. Sestamibi scanning is an improvement over thallium-technetium scanning that was used in the past. This scanning allows more confident unilateral exploration with high cure rates, low morbidity and early patient discharge.

Experience with minimally invasive endoscopic parathyroidectomy has been reported. The first such operation performed was described by Gagner in 1996 [1]. This was performed entirely under a steady flow of gas, using an endoscope introduced through a central trocar and two or three additional trocars for the instruments. Although this procedure is limited to well-defined indications, it can even be used for thyroidectomy. While the benefits of this approach are somewhat controversial, it gained some popularity among patients and even among surgeons. Minimally invasive video-assisted parathyroidectomy and video-assisted parathyroidectomy by the lateral approach were also reported.

Udelsman [2] reviewed the outcomes of 656 consecutive parathyroid explorations and compared the results of conventional and minimally invasive parathyroidectomy techniques. A total of 401 procedures (61%) was performed using the standard technique and 255 patients (39%) were selected for the minimally invasive technique. The success rate for the entire series was 98%, with no significant differences between techniques. The overall complication rate of 2.3% reflects 3.0% and 1.2% rates in the standard and MIP groups, respectively. MIP was associated with approximately 50% reduction in operating time, a sevenfold reduction in length of hospital stay, and a nearly 50% reduction in total hospital charges.

Although the incidence of multiglandular disease is controversial, it may be encountered in up to 9% of cases. This should be taken into consideration when performing this limited procedure as an additional adenoma may be missed. Supplementation with a quick PTH assay may assist in ruling this out.

Another novel approach to parathyroid surgery is that of minimally invasive radio-guided parathyroidectomy. This is based on the intraoperative detection of the parathyroid adenoma under the guidance of a gamma probe, taking advantage of sestamibi scanning [3]. This technique allows the removal of the parathyroid adenoma through a small skin incision. However, accurate preoperative imaging is mandatory not only to distinguish patients

PTH = parathormone

MIP = minimally invasive parathyroidectomy

with a solitary parathyroid adenoma from those with multiglandular disease but also to diagnose patients with concomitant thyroid nodule or nodules that can cause false-positive results with radio-guided surgery. Some authors suggest the intraoperative use of a gamma probe as a useful adjunct, especially in revision cases [4,5]. Others claim that it is less accurate than preoperative technetium 99m-sestamibi imaging in localizing abnormal parathyroid glands [6,7], or it is not recommended altogether [8]. Saarito et al. [6], who compared preoperative imaging and intraoperative gamma probe localization in patients with primary hyperparathyroidism, confirmed a single parathyroid adenoma in 16 of 20 patients and hyperplasia in 4 patients. The sensitivity of the preoperative scan was 81% (13 of 16 patients) in adenoma patients and 100% (4 of 4 patients) in hyperplasia. Only 8 of 16 adenomas were correctly detected (sensitivity 50%), and none of the hyperplastic glands was correctly detected. This may be attributed to surgeon expertise in the use of an innovative technique in a small patient cohort, but it does raise questions regarding the indication for its use.

Inabnet et al. [8] retrospectively studied the benefit of using intraoperative radio-guidance in parathyroid operations in 130 patients. Of these, 60 patients underwent radio-guided parathyroidectomy. Prior to surgery, a solitary parathyroid adenoma was visualized on technetium ^{99m}Tc sestamibi scintigraphy in all patients and all were cured following parathyroidectomy. In 29 patients (48%) the probe provided confusing or inaccurate information. Forty-three cases were completed under local anesthesia and 85% were discharged home on the same day. The authors conclude that the routine use of radio-guidance is not recommended during parathyroidectomy.

In the present issue of *IMAJ*, Nageris et al. [9] describe the technique of using a hand-held gamma ray probe for intraoperative localization of the parathyroid glands during revision surgery. They report their experience with six patients operated for residual disease during the years 1997–1998. Their report provides a fair description of the technique and is important in illustrating it to those who are unfamiliar with this approach. However, one has to wonder why in a patient undergoing surgery in 1998, we should read about a scheduling for a sternotomy rather than read about its being performed or if not, why? (patient 6). Moreover, the authors conclude that they use scintigraphy and ultrasound preoperatively and use the intraoperative guidance in cases of re-exploration. With 70 annual cases as described, it is a concern that no further data are provided on use of this technique in more patients operated on since 1998. This lack of further information could be attributed to data accumulation and this is acceptable. Yet, for those of us who perform parathyroidectomy on a routine basis, more definitive conclusions on the pros and cons of using a hand-held gamma ray probe would have been useful.

Shaha et al. [7] suggest that if the preoperative sestamibi scan is strongly positive, the gamma probe is unlikely to assist much during the surgical procedure, and that if the preoperative scan is negative, the role of the gamma probe to correctly identify the enlarged parathyroid gland with the high count remains to be determined.

I have used a hand-held gamma ray probe sporadically when it became available in our institution, and although we performed no prospective controlled study of its value I did not find it useful in routine cases. I do usually insist, however, on preoperative localization with ^{99m}Tc-MIBI and occasionally on high resolution neck ultrasonography as well, and have had good results with this preoperative analysis.

In conclusion, the gamma probe is another new weapon in our armamentarium that is available for use for those who so desire or have a need for it. The administered radiation dose is negligible, and although the price of the instrumentation may be prohibitive it may be of value in selected cases.

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Correspondence: Dr. Y.P. Talmi, Dept. of Otolaryngology, Head and Neck Surgery, Sheba Medical Center, Tel Hashomer 52621, Israel.
email: ytalmi@012.net.il