Minimally invasive parathyroid surgery

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The standard surgical management of primary hyperparathyroidism has been challenged during the past two decades by the development of improved imaging techniques, the availability of rapid intraoperative PTH (parathyroid hormone) assay, and a trend toward minimally invasive surgical procedures. Although there has been an increasing incidence of disease, and much debate on indications, including the avoidance of neurocognitive effects [1], this editorial will focus on the nature of minimally invasive parathyroid surgery and the imaging which makes this possible. A recent article by McVeigh et al. [2] presents their series of 248 parathyroid procedures, of which 129 were performed in a minimally invasive fashion, performed

over a period of 10 years. The changes in their technique over this period of time are reflective of many of the trends in parathyroid surgery worldwide toward a minimally invasive approach, and may be used as an example of these trends, although the study does not elaborate on the details of the follow-up and long-term results in their patients.

The term “minimally invasive” as applied to parathyroid surgery has various definitions which may include any or all of the following: single gland or unilateral exploration, a small incision—usually 3 cm in length or less, utilization of intraoperative PTH assay, and avoidance of general anesthesia. Although endoscopic parathyroidectomy has been performed, this technique has never entered the “mainstream” because of the disadvantages of multiple incisions including one large enough to remove the lesion, the need for neck insufflation, the requirement for general anesthesia, and a steep learning curve [3]. Therefore, it is best to avoid using the term “open” parathyroid surgery as the vast majority of minimally invasive parathyroidectomy is “open” but performed through a small incision (though occasionally video assistance may be utilized [4]). Instead, defining what one means by minimally invasive is important, and if “conversion” to a conventional four-gland exploration, a larger incision, or if general anesthesia is required, this should be delineated in reporting and classifying the operation.

Minimally invasive techniques have been widely adopted due to the recognition that the majority of patients with hyperparathyroidism have single gland disease [5]. If the single hyperfunctioning gland can be removed in a less invasive fashion, and cure assured, then the older standard of four-gland exploration under general anesthesia with a generous incision is unnecessary. Intraoperative PTH monitoring has been shown to greatly increase the likelihood of cure without the need to visually inspect all four

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parathyroid glands [6–8] and is generally relied upon to confirm cure after a limited exploration.

An important aspect of minimally invasive parathyroid surgery is the type of anesthetic utilized [9]. One important potential advantage of minimally invasive parathyroid surgery is the possibility of minimizing the anesthetic agents and the avoidance of endotracheal intubation or laryngeal mask airway placement. With proper understanding and experience with local and regional anesthetic techniques as well reasonable patient selection, a majority of patients can avoid the potential complications of general anesthesia. This also facilitates ability to discharge the patient home shortly after the procedure has been completed. One problem with this technique, although not related to outcome, is the difficulty in teaching the procedure to young surgeons. The small incision limits visibility to anyone except the primary operator, and the operation requires meticulous and controlled movements with little margin for error, precluding much assistance except for retraction. The patient is often sufficiently awake to overhear the dialog between surgeon and trainee.

The availability of preoperative localizing imaging is crucial to the ability to perform minimally invasive parathyroid surgery. 99mTC-Sestamibi scanning has been utilized for almost three decades to help localize hyperfunctioning parathyroid lesions. The quality of these scans has generally improved but remains dependent on the techniques and the physicians interpreting the images. Many facilities still utilize only a single radioisotope scan depending solely on hyperconcentration and delayed retention by the diseased parathyroid gland or glands. However, a double isotope study, with comparison of pertechnetate and sestamibi images can be very useful in determining the location of parathyroid lesions not evident on single isotope studies [10, 11]. Finally, obtaining sestamibi images at least 4 h after injection can increase the sensitivity of the examination. It is impossible to determine in the literature whether the use of the intraoperative nuclear medicine probe makes a difference in outcome [12]. As the vast majority of endocrine surgeons do not utilize the probe and have equivalent outcomes to those surgeons who do [5], it seems to be an unnecessary adjunct.

Over the last decade, the use of scintigraphy as the best imaging modality has been called into question. Surgeons and endocrinologists have become comfortable with office and intraoperative sonographic examination of their patients giving rise to a generation of physicians who have a greater understanding of surgical and sonographic anatomy. Some have utilized sonogram guided fine needle aspiration with analysis of the aspirate for elevated PTH levels confirming the pathology. Performing ultrasound on the extended neck minutes before surgery can be very advantageous to the planning of the incision location and

the extent of surgery necessary. Finally, the convenience of applying the ultrasound probe to the neck at the initial patient visit can be very gratifying and useful. Every study on the use of ultrasound for parathyroid localization reports the fact that it is user dependent [5]. Thus, as surgeons and endocrinologists become more facile with the technique and interpretation, its importance as an imaging option will continue to rise [13].

High resolution, thin cut, multi-phase computed tomography (CT) scanning (sometimes labeled “4D CT”) has also been shown to be quite useful, and some groups have begun using it in place of nuclear scanning. Parathyroid lesions have characteristic features distinguishing them from other structures, and the anatomical detail of the CT scan is much more accurate than the nuclear scan. Inabnet et al. [14] have shown that with a properly fashioned protocol, the radiation dose is equivalent to the nuclear scan. The exam takes only several minutes to complete making it much more convenient, so that the only real disadvantage compared to the nuclear scan is the necessity of administering intravenous contrast. It is quite possible that as this CT technique gains familiarity, it will become the first line imaging localization modality utilized [15]. A variation in the use of CT imaging for parathyroid localization is an imaging technique utilizing both contrast-enhanced CT and sestamibi-Single Photon Emission CT (SPECT) imaging, or CT-mibi “fusion” [16]. This technique capitalizes on the fusion of both a physiologic (nuclear) and anatomic (CT) image to provide correlative information on the location of hyperfunctioning parathyroid tissue. It has been shown to be efficient in the localization of both eutopic and ectopic parathyroid lesions in both initial and reoperative parathyroid exploration [17].

The assumption that minimally invasive parathyroid surgery has equivalent results to four gland exploration has recently been called into question by Norman et al. [18] and by Siperstein et al. [19], both of whom now use four-gland exploration on virtually all patients. Reservations have been expressed about Norman’s reported outcomes [20], but they are hard to ignore, given the huge volume of cases and his experience that minimally invasive techniques have produced significantly more failures, despite his previous claims to the contrary. One theory to explain these findings is that two distinct populations of patients with primary hyperparathyroidism are being surgically treated early in disease presentation. One cohort of patients with disease demonstrate the typical biochemical presentation of overt concurrent elevation of PTH and serum calcium; the second with more subtle biochemical aberration of low index PTH levels. The latter population has been shown to manifest a higher incidence of multigland disease, perhaps as a result of asymmetric sporadic hyperplasia, despite localization and intraoperative PTH

findings characteristic for single gland disease [21]. It is in this population that a targeted surgical approach may be least appropriate, given intraoperative PTH results which ultimately may not predict long-term eucalcemia. At this point in time, it seems that the majority of endocrine surgeons continue to employ minimally invasive techniques with the realization that four-gland exploration should be utilized when there is any doubt of cure. Perhaps, this will lead to a critical appraisal of the thresholds of intraoperative PTH decrease to predict cure and experimentation with tools such as a preoperative nomogram to determine usefulness of the assay [22].

In conclusion, the concept that 90 % of cases of primary hyperparathyroidism are caused by a single adenoma along with the availability of intraoperative PTH assay and the development of improved imaging modalities has allowed the development of minimally invasive parathyroid surgical techniques. These include smaller incisions, limited exploration, avoidance of general anesthesia, and same day discharge. Although the long-term results of limited exploration have been subject to some doubt, the advantages of minimally invasive parathyroidectomy will continue to present a compelling argument for choice of this technique by patients and surgeons in the years to come.

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