

# Minimally Invasive Endocrine Surgery

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## Abstract

**Background:** Minimally invasive endocrine surgery has experienced multiple new developments.

**Methods:** Comprehensive review of the literature.

**Conclusions:** Minimally invasive techniques can be efficaciously and safely applied to most endocrine disorders. Endocrine surgeons should be skilled in these techniques in order to individualize the operative approach.

**Key Words:** Laparoscopy, parathyroidectomy, adrenalectomy, thyroidectomy, minimally invasive endoscopy.

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## Introduction

LAPAROSCOPY has revolutionized surgery over the past decade. As with so many other diseases and conditions heretofore requiring general surgery, the advances made in minimally invasive technique have changed the treatment of endocrine disease. In fact, endoscopic surgery has become the preferred approach for many of the benign endocrine diseases. Various approaches have been described in the literature for the same diseases; hence, much debate exists over which methods are most efficacious. This article will review the approaches currently being discussed, in an attempt to highlight the indications and advantages/disadvantages of each method.

### Laparoscopic Adrenalectomy

Laparoscopic adrenalectomy, first described by Gagner and colleagues in 1992, has become the procedure of choice for the removal of most adrenal pathology (1). Although a technically

challenging procedure, surgeons with advanced laparoscopic technique can learn how to perform this operation in a safe, efficient manner.

The meticulous preoperative work-up of patients with adrenal disease must encompass both chemical and radiographic studies to diagnose and localize pathology. In particular, it is important to investigate the possibility of multiple endocrine neoplasia (MEN) syndromes, particularly in a patient with a diagnosed pheochromocytoma and a significant family history. When investigating a particular lesion, 24-hour urinary catecholamines and metabolites, cortisol, aldosterone and testosterone/estrogen levels are measured to help determine the cellular origin. In addition, computed tomography (CT) scans, magnetic resonance imaging (MRI), and scintigraphy (i.e., metaiodobenzyl guanidine I 123 [MIBG] scan for pheochromocytoma) are important radiographic modalities to use in its identification and localization (2). It is generally agreed that all functioning adrenal tumors should be resected, regardless of size. For incidentally detected, non-functioning tumors, the size of the lesion plays a role in recommending surgery. Lesions smaller than 3 cm can be followed with close surveillance, whereas lesions larger than 6 cm should be resected, due to the increased risk of malignancy. Nonfunctioning adrenal masses of an intermediate size (i.e., 3–6 cm) should be approached on a case-by-case basis: younger

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patients may benefit from adrenalectomy, whereas surveillance may be preferred for older patients.

Although there are some relative and absolute contraindications to laparoscopy, the vast majority of patients would benefit from this approach. Various studies have investigated the advantages and disadvantages of laparoscopic vs. open adrenalectomy. Prinz compared these two approaches directly for patients with unilateral lesions less than 10 cm in diameter (3). The two open procedures included in the study were the transabdominal and posterior approaches. The length of the procedure was not significantly different, particularly as experience in the laparoscopic approach improved. More significant, however, were the shorter length of stay and decreased use of postoperative analgesics. Gagner et al. (5) had similar results when they studied 100 consecutive laparoscopic adrenalectomies. In addition, they considered the absolute and relative contraindications to the procedure. Essentially, the only absolute contraindication is a patient with adrenal carcinoma. The possibility of local disease requiring extensive *en bloc* resection makes the open technique a more favorable choice. Relative contraindications include patients with lesions larger than 10 cm, a history of multiple intra-abdominal operations, and diagnosis of malignant pheochromocytomas that extend into periaortic lymph nodes (4, 5). MIBG scans or MRI may localize these malignant lesions and thus influence the decision to perform an open procedure (4). In addition, large lesions with an extensive vascular supply would allow only limited exposure for dissection; thus, an open approach may be safer and potentially less time-consuming (5).

The laparoscopic retroperitoneal approach has also been described in the literature. Unlike the transabdominal techniques described by Gagner and Prinz, the retroperitoneal approach does not provide the ability to explore the abdomen for malignancy and can limit the visibility needed for dissection. On the other hand, a retroperitoneal dissection may be advantageous for patients with a history of prior abdominal surgery and for those requiring bilateral adrenalectomy. Although most surgeons utilize the transabdominal approach, the retroperitoneal technique is a viable option (2).

Laparoscopic resection of pheochromocytomas has been a subject of debate since the approach was first described. Some surgeons argue that intraoperative cardiovascular stabil-

ity would be at greater risk with laparoscopy because of CO<sub>2</sub> pneumoperitoneum. Various studies have concluded, however, that although intraoperative and postoperative cardiovascular complications are higher in patients diagnosed with pheochromocytoma, such findings are no different than those from the open approach (6, 7). In fact, studies have shown that the rate of cardiovascular complications is lower with laparoscopy (7). One reason for the improvement is that laparoscopic mobilization of a pheochromocytoma allows the surgeon to "resect the patient from the tumor" and thereby minimizes catecholamine release. Hence, it is generally accepted that the laparoscopic approach is a safe and effective way to remove pheochromocytomas (1, 3–7).

### Endoscopic Endocrine Surgery in the Neck

Endoscopic endocrine surgery in the neck became a viable surgical option in 1996 with the description of the first endoscopic parathyroidectomy by Gagner and associates (8). Continued research by surgeons around the world has resulted in descriptions of different operative approaches, relative and absolute contraindications, and recommendations about which patients would benefit most from these minimally invasive techniques. All would agree, however, that endoscopic endocrine surgery requires that the surgeon be familiar with open endocrine surgery and have the advanced laparoscopic skills necessary to perform the procedure safely.

### Minimally Invasive Parathyroid Surgery

Improvements in preoperative localization and the availability of intraoperative parathyroid hormone (PTH) monitoring have significantly changed the approach to parathyroid surgery (9). A focused approach is indicated for patients with primary, sporadic hyperparathyroidism and a single adenoma depicted on preoperative imaging. The three preferred techniques utilize preoperative localization with ultrasound and/or sestamibi scan and intraoperative use of a rapid PTH assay (8–16). The radiographic localization studies all contribute important information to the surgeon. Ultrasound can provide specific anatomic information and help delineate other thyroid pathology, whereas the sestamibi scan can confirm the position of the adenoma, and localize lesions present in the mediastinum. The intraoperative PTH assay is

also critical to the success of minimally invasive surgery. This test, which is performed in the operating room, analyzes the PTH level preoperatively, upon manipulation of the gland, and 5, 10, and 30 minutes after excision. If there is a 50% reduction in the preoperative PTH level, then the operation is completed. If, however, the appropriate decrease is not obtained, then a bilateral neck exploration is performed (9).

The three minimally invasive techniques used for parathyroid surgery are the video-assisted technique introduced by Miccoli, the endoscopic approach described by Gagner, which uses continuous CO<sub>2</sub> insufflation, and the unilateral neck exploration performed under local anesthesia (8, 10, 12). Each of these approaches has its own advantages and disadvantages. Both the video-assisted and endoscopic techniques require general anesthesia and are associated with longer operative times. On the other hand, the cosmetic result and visibility obtained with the magnifying laparoscope are advantageous. In addition, the endoscopic techniques can be utilized for bilateral or mediastinal exploration (8, 10, 12). The unilateral approach is performed through small, cosmetically acceptable incisions and is associated with shorter operative times. In addition, this procedure can be performed under local anesthesia and often on an outpatient basis. Unfortunately, this technique does not provide the visibility obtained with the endoscope, and if the PTH assay does not decrease adequately, then an open bilateral exploration becomes necessary (9).

### Endoscopic Thyroid Surgery

Endoscopic thyroidectomy has been studied in small consecutive groups of patients and compared to conventional surgery (12, 18, 19). Two techniques have been described: the video-assisted technique described by Miccoli and the endoscopic technique described by Gagner and Inabnet (16–18). Both methods have been utilized successfully in the subset of patients with thyroid pathology amenable to the endoscopic approach. In some reports, the use of CO<sub>2</sub> in the neck has been shown to result in hypercarbia and respiratory acidosis (20). Fortunately, when encountered, it has resolved with no significant sequelae. In fact, Ochiai et al. report five cases of endoscopic thyroidectomy where hypercarbia was not encountered, when CO<sub>2</sub> insufflation pressures were maintained around 6 mm Hg (21).

Regardless of the method chosen, proponents of endoscopic thyroid surgery agree that appropriate patient selection is critical. All patients should undergo an adequate work-up, which includes thyroid function tests, ultrasound examination, and fine needle aspiration (FNA) (16). Patients with an FNA that shows atypia or other suspicious pathology should undergo an open procedure, because of the higher risk of malignancy. Currently, patients with a diagnosis of thyroid carcinoma are not candidates for endoscopic surgery (17). The lesions most amenable to the minimally invasive approach include lesions that are follicular in origin (as determined by FNA), Hurthle cell tumors, indeterminate nodules, solitary toxic nodules and thyroid cysts (18). Other contraindications to this procedure include the size of the lesion, multinodular goiter, prior neck surgery, and a body habitus that would preclude adequate visibility with insufflation (e.g., morbidly obese patients with short, thick necks). Inabnet et al. suggest that the endoscopic approach not be utilized for lesions larger than 3 cm, for the limited working space in the neck decreases exposure (17).

Studies have shown improved cosmetic results and faster recovery time with the use of both endoscopic approaches. Neither, however, has led to a decrease in the use of analgesics postoperatively. Surgeons using this method have commented on the improved intraoperative visibility with use of the magnifying laparoscope (18, 19). Identification of the structures in the neck is always a major concern of the endocrine surgeon. Since these techniques facilitate such identification, they may result in a decrease in the morbidity associated with injury to major structures like the recurrent laryngeal nerve. One universal disadvantage is the prolonged operative time needed for this approach. This, however, should diminish as surgeons become more experienced in the utilization of endoscopy for thyroid surgery (17).

### Laparoscopic Pancreatic Surgery

A decade prior to the universal acceptance of minimally invasive surgery for the treatment of benign gallbladder disease, diagnostic laparoscopy was utilized to investigate the pancreas (22). Throughout the 1990s, as laparoscopy was becoming popular for treatment of a variety of surgical diseases, laparoscopic pancreatic surgery was slowly being improved. Today there are some clear indications for min-

imally invasive pancreatic surgery, though the actual practice is limited by the need for experience in open pancreatic surgery and expertise in advanced laparoscopic technique. Although this field continues to develop, laparoscopic pancreatic surgery is an already effective and reliable approach in defined clinical scenarios.

Diagnostic laparoscopy is an important adjunct to the treatment of pancreatic malignancy. Although not recommended for surgical ablation of disease, its use in determining resectability is critical. One of the most important diagnostic modalities used in the work-up of a patient with suspected malignancy is the CT scan. This modality is very accurate when determining unresectability; however, it has been less effective in determining resectability (23, 24). Laparoscopy, when utilized in the face of an indeterminate radiologic study, can decrease the morbidity associated with a laparotomy and extensive dissection. Before surgeons became more adept in laparoscopic technique, the ability to determine resectability was less than 50%, which is worse than with CT scan alone (23). However, as laparoscopic skill improved, diagnostic techniques developed to include more extensive dissection of critical areas. Such advances in technique have led to visualization of the celiac axis, hepatic artery, superior mesenteric vein and superior mesenteric artery, and even biopsy of the celiac, portal and perigastric nodes (23, 25). In addition, the use of intraoperative ultrasound has added another modality to diagnostic laparoscopy, and has been shown to increase the accuracy of determining resectability (26). Although this modality is operator dependent, when used by properly trained personnel it can offer a clear advantage. Even with the recent advances in spiral CT scans, diagnostic laparoscopy with intraoperative ultrasound seems to offer a more accurate means of determining resectability.

When unresectability is determined via radiographic or surgical means, laparoscopy can be utilized for palliative treatment (25–28). Since life expectancy is short when metastatic pancreatic cancer is diagnosed, decompression of the biliary obstruction may be palliative with the placement of stents. However, when complications develop following stent placement, or the endoscopist is unable to place the device, then surgical decompression becomes necessary. In addition, obstruction of the gastric outlet by the tumor may require surgical intervention. Laparoscopic biliary decompression and gastric/duodenal decompression are well de-

scribed in the literature (27, 28). The most common method of biliary decompression is cholecystojejunostomy, for this procedure is faster and more technically feasible than choledochojejunostomy. Gastric outlet obstruction is treated with a gastrojejunostomy. Rhodes et al. point out in their study that the decreased length of hospital stay and faster recovery time offer a distinct advantage to this patient population. They performed the procedure in patients with complications from biliary stents, those with gastric outlet obstruction, and those found to have unresectable disease while undergoing diagnostic laparoscopy for what was thought to be resectable disease. The procedure was successfully completed in 15 of 16 patients. The length of the procedure averaged 75 minutes, and 14 of 16 patients were discharged within 7 days (28). Laparoscopy, when indicated and feasible, clearly offers an advantage when surgical treatment is necessary.

Laparoscopy has also been utilized for the internal drainage of persistent, large pancreatic pseudocysts. Both laparoscopic cystogastrostomy and cystojejunostomy have been described, with the former being more common (29). Different approaches to this disease have been described. One approach permits access to the posterior stomach via an enterostomy in the anterior stomach. This procedure has had good results, although it requires two gastrostomies. The other method approaches the posterior stomach through the gastrocolic ligament inferiorly. Although technically more challenging, this procedure is equally effective (25). Laparoscopic drainage of pseudocysts offers the advantage of a definitive procedure without the morbidity of laparotomy in an inherently sicker population.

Finally, laparoscopic pancreatic resection has been described for both benign neoplasms and chronic pancreatitis. Benign cystadenomas and endocrine tumors, particularly insulinomas, can be effectively treated by either enucleation or distal pancreatectomy, with or without splenectomy (26, 30–32). In addition, distal pancreatic resection for intractable pain associated with chronic pancreatitis has shown favorable results, although this procedure typically requires a splenectomy, because of the extensive retroperitoneal fibrosis associated with this disease process (30). Patterson et al. looked at a single-institution review of 19 pancreatic resections (32). In that study, 2 of the 19 were converted to open procedures, one for bleeding and the other for suspicion of malignancy. A pan-

creatic fistula complicated 16% of the cases, which is comparable to results with the open technique. Overall, it appears that the hospital length of stay is shorter and the recovery time is faster for laparoscopic patients (32). As with all advanced laparoscopic techniques, enucleation of endocrine tumors and distal pancreatectomy are safe and effective surgical treatment options for patients with pancreatic disease when performed by surgeons with the necessary experience and laparoscopic skills.

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