Results of Laparoscopic Adrenalectomy for Suspected and Unsuspected Malignant Adrenal Neoplasms

Electron Kebebew, MD; Allan E. Siperstein, MD; Orlo H. Clark, MD; Quan-Yang Duh, MD

Background: Laparoscopic resection for malignant adrenal tumors is controversial, because they are rare and limited data exist in the literature.

Hypothesis: Laparoscopic adrenalectomy for malignant adrenal tumors is safe and effective.

Patients and Methods: Twenty-three patients who had a laparoscopic approach for suspected and unsuspected malignant adrenal tumors were studied retrospectively. The adrenal mass was suspected to be metastatic if the patient had a history of previous extra-adrenal primary malignancy and/or positive fine-needle aspiration cytologic findings. A primary adrenal cancer was suspected if there were positive fine-needle aspiration cytologic findings and/or a malignant adrenal imaging phenotype.

Main Outcome Measures: (1) Margins of tumor resection, (2) tumor recurrence (locoregional, port site, and distant), and (3) disease-free survival.

Results: Twenty-three patients (15 men and 8 women) had 24 laparoscopic procedures (20 adrenalectomies, 3 biopsies, and 1 diagnostic laparoscopy). Permanent histologic specimens in the 23 patients showed 5 adrenocortical cancers, 1 undifferentiated adrenal cancer, 13 adrenal metastases, 2 lymphomas, and 2 cases with no evidence of tumor. Clinically suspected adrenal metastases were true positive in 19 patients (83%). The sensitivity of fine-needle aspiration cytology was 57% (n=7). Only 1 of 6 patients with primary adrenal cancer was suspected to have a malignant tumor preoperatively. The tumor resection margin was negative in all adrenalectomies. There were 3 locoregional recurrences (2 local and 1 lymph node metastasis) in the 6 patients with primary adrenal cancer, no port site recurrences, and 4 distant recurrences in 13 patients with metastatic adrenal tumors. The disease-free survival was 65% at a mean follow-up time of 3.3 years (range, 1-7 years).

Conclusions: A laparoscopic approach in patients with suspected adrenal metastasis can be both diagnostic and therapeutic, and achieves complete tumor resection. In contrast, laparoscopic adrenalectomy for clinically unsuspected adrenocortical cancer is associated with a high recurrence rate. Furthermore, preoperative fine-needle aspiration cytology for the evaluation of suspected malignant adrenal tumors is unreliable.

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LAPAROSCOPIC ADRENALECTOMY has emerged as the treatment of choice for benign functioning and nonfunctioning surgical adrenal disorders.1-3 Laparoscopic adrenalectomy is effective and safe.3 When compared with open adrenalectomy, laparoscopic adrenalectomy is associated with a shorter length of hospitalization, lower analgesic requirement, decreased convalescence, less operative blood loss, rapid dietary intake, superior cosmesis, and lower postoperative complication rates.4-8 Because of the improved patient outcome and increased experience with laparoscopic adrenalectomy, some centers have extended their indication for laparoscopic adrenalectomy to include large primary adrenal tumors with malignant potential and adrenal metastasis.9,10 Advances in minimally invasive surgery, improved technology, and experiences with laparoscopic techniques have led to the use of laparoscopy for the resection of cancers involving the uterus, colon, prostate, and kidney. Proponents of a laparoscopic approach for cancer maintain that the principles of open oncologic resection can be maintained in most cases.9 The use of laparoscopic adrenalectomy for potentially malignant primary adrenal tumors or adrenal metastasis is controversial.13,14 However, limited data are available in the literature regarding the results of laparoscopic adrenalectomy for malignant adrenal tumors.9,11-13 These reports have been limited to case reports or small
PATIENTS AND METHODS

A retrospective study was conducted of patients who had had a laparoscopic approach for suspected and unsuspected primary malignant and metastatic adrenal tumors. Between January 1, 1993, and December 31, 2001, 215 patients underwent a laparoscopic approach for adrenal neoplasms at the University of California, San Francisco, hospitals. Twenty-three patients had suspected or unsuspected malignant adrenal primary or metastatic neoplasm. Clinical history and presentations, preoperative imaging studies (computed tomographic scan, magnetic resonance imaging, ultrasound, or positron emission tomographic scan), operative procedures and findings, pathological findings, and postoperative course were reviewed.

A primary adrenal neoplasm was suspected to be malignant if (1) a preoperative fine-needle aspiration (FNA) cytologic study was positive for malignant cells, or (2) a preoperative imaging study showed malignant characteristics (local invasion, obliteration of fat planes between the adrenal gland or mass and adjacent structures, irregular shape and border, evidence of intra-abdominal metastases or lymphadenopathy, or associated inferior vena cava thrombus), and (3) no history of extra-adrenal primary cancer was present. An adrenal mass was suspected to be a metastasis if (1) the patient had a previous or current history of extra-adrenal primary malignancy or (2) a preoperative FNA cytologic study was positive for metastasis. If the above criteria were not present, then the adrenal mass was not suspected to be a primary adrenal cancer or an adrenal metastasis.

Follow-up data were obtained from the University of California, San Francisco, Cancer Registry, clinic follow-up visits, and direct contact of patients. Follow-up was completed for all patients up to March 2001. Sensitivity of clinically suspected primary malignant and metastatic adrenal neoplasm was calculated (true positive/[true positive + false negative]) by means of the criteria mentioned above. Similarly, the sensitivity of preoperative FNA cytologic study was also determined.

cohort studies with short follow-up time.2,11-13 We wanted to evaluate a larger cohort with a longer follow-up time to determine the outcome of patients who had malignant primary or metastatic adrenal tumors resected laparoscopically. We reviewed our experience, from 1993 to 2001, with 215 laparoscopic approaches for adrenal neoplasm to determine (1) recurrence rates (locoregional, port site, or distant) after laparoscopic adrenalectomy, (2) surgical resection margins, and (3) disease-free survival in patients with malignant adrenal tumors.

RESULTS

From 1993 to 2001, 23 patients with a mean age of 61.7 years underwent a laparoscopic approach for suspected or unsuspected malignant primary and metastatic aden-

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<thead>
<tr>
<th>Characteristic</th>
<th>Finding</th>
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<tr>
<td>Sex, No. M/F</td>
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<tr>
<td>Type of laparoscopic approach, No. lateral/posterior</td>
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<tr>
<td>Type of laparoscopic procedure, No. Adrenalectomy</td>
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<td>Side of adrenalectomy, No. left/right</td>
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<tr>
<td>Size of adrenal tumor, mean (range), cm</td>
<td>5.1 (1.5-12)</td>
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<tr>
<td>Operative time, mean (range), min</td>
<td>166 (90-225)</td>
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<td>Length of hospitalization, mean (range), d</td>
<td>2.75 (1-14)</td>
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<td>Perioperative complications, No.</td>
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<td>Ileus</td>
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<tr>
<td>Tumor margin of resection, No. Negative</td>
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<td>Positive</td>
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<tr>
<td>Adrenocortical carcinoma</td>
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<td>Undifferentiated adrenal carcinoma</td>
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<tr>
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<tr>
<td>Non–small cell lung carcinoma</td>
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<td>Preoperative fine-needle aspiration cytologic finding, No. Positive</td>
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<tr>
<td>Distant</td>
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<tr>
<td>Follow-up time, mean (range), y</td>
<td>3.3 (1-7)</td>
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Clinical, Operative, and Pathological Characteristics of 23 Patients With Suspected and Unsuspected Malignant Adrenal Neoplasm

cinal tumors (Table). These 23 patients underwent 24 laparoscopic procedures: 20 laparoscopic adrenalectomies, 3 biopsies, and 1 diagnostic laparoscopy. The overall complication rate was 12.5%. A 75-year-old man with a synchronous 5-cm adrenal tumor and non–small cell lung carcinoma had a posterior laparoscopic approach but required conversion to an open approach because of intraoperative bleeding. A 77-year-old man who presented with Cushing syndrome from an unsuspected adrenocortical cancer developed a postoperative pulmonary embolus after laparoscopic adrenalectomy. Finally, a 76-year-old man who had a laparoscopic biopsy and drainage of an unresectable, symptomatic, 12-cm cystic adrenal metastasis from a small cell lung carcinoma had prolonged ileus (5 days).

Six patients had primary adrenal cancers: 4 patients presented with an incidentaloma and 2 patients presented with Cushing syndrome. Only 1 of these 6 patients was suspected to have a malignant tumor preoperatively and underwent an elective open adrenalectomy after a diagnostic laparoscopy confirmed extensive
local invasion. The mean tumor size in the 6 patients with primary adrenal cancers was 6.6 cm (range, 2.5-12 cm). One patient with a 2.5-cm adrenocortical carcinoma was initially misdiagnosed as having a cortical adenoma, but she later developed local recurrence with lung metastasis, confirming a diagnosis of adrenocortical carcinoma. All the surgical tumor margins were negative in the patients with primary adrenal cancer. In the remaining 17 patients who were suspected to have adrenal metastases, permanent histologic specimens showed 7 non–small cell lung carcinomas, 3 renal cell carcinomas, 2 lymphomas, 1 melanoma, 1 small cell lung cancer, and 1 case of bilateral adrenal metastases from a colon cancer. Two patients had no evidence of neoplasm after biopsy; 1 patient had a history of metastatic Merkel cell carcinoma and nodular normal adrenal tissue on histologic examination, and the other patient had a history of lymphoma with histologic examination showing only fibroadipose tissue. The mean adrenal metastasis tumor size was 4.8 cm (range, 1.5-12 cm). In all of the patients with adrenal metastasis who had laparoscopic adrenalectomy, the tumor resection margins were negative and there was no invasion outside the adrenal gland. Of the 13 patients with metastatic adrenal tumors, 11 were metachronous metastases (6 non–small cell lung carcinomas, 3 renal cell carcinomas, and 1 bilateral colon adenocarcinoma), and these patients underwent adrenalectomy for curative intent; 2 were synchronous metastases, and these patients underwent adrenalectomy for tissue diagnosis and staging.

On the basis of the clinical criteria used, the sensitivity of clinically suspected adrenal metastasis was 83%, whereas it was only 16.5% for primary adrenal cancer. The sensitivity of preoperative FNA cytologic examination was only 57% (4 of 6 true positives for adrenal metastases and 0 of 1 true positive for primary adrenal cancer).

In patients who underwent laparoscopic adrenalectomy, the overall disease-free survival was 65% at a mean follow-up time of 3.3 years (range, 1-7 years). Three patients who had primary adrenal cancer and laparoscopic adrenalectomy developed recurrences: 2 local and 1 lymph node metastasis. All 3 patients with adrenocortical carcinoma underwent open reoperation and resection, and only 1 patient was disease free at last follow-up. Four of the 13 patients with metastatic adrenal tumors had distant recurrences. All 4 patients with distant recurrences were thought to have a solitary adrenal metastasis at the time of their laparoscopic adrenalectomy.

**COMMENT**

The role of laparoscopy for malignant adrenal tumors is controversial, because they are rare and limited outcome data exist in the literature.

Unfortunately, the literature that does exist is contradictory. For example, a case report of laparoscopic adrenalectomy for a 5 × 4.5-cm adrenal cancer resulting in diffuse peritoneal dissemination and eventual death of a patient is alarming.

In contrast, Heniford and colleagues, in a 2-institution review of 10 patients with metastatic adrenal tumors and 1 patient with adrenal carcinoma, reported no local or port site recurrences at a mean follow-up time of 8.3 months. Thus, the current available literature is sparse to allow treatment management recommendation for potentially malignant primary or metastatic adrenal neoplasm. Unlike for colon cancer, a prospective randomized study comparing open with laparoscopic adrenalectomy is impractical because of the rarity of primary adrenal malignancies and metastatic adrenal tumors. We believe our study provides a better assessment of the risk of recurrence and laparoscopic resectability of primary adrenal cancers and adrenal metastasis because it has a longer follow-up time and a larger study cohort.

Unfortunately, it is difficult to determine the malignant potential of adrenal neoplasm because there is no reliable preoperative diagnostic test. The size of adrenal neoplasm has been used by some investigators to predict the risk of malignancy for adrenal incidentalomas, but no consensus exists. Generally, most centers have used adrenal tumor size of 5 to 6 cm or greater as an absolute indication for resection because the risk of malignancy is high (35% to 98%). It is unclear, however, at what size an adrenal neoplasm should be resected by means of an open approach or a laparoscopic approach. Some surgeons have laparoscopically resected adrenal tumors up to 15 cm in size. Furthermore, Linos and Styloupolos have also documented that adrenal imaging tended to underestimate adrenal tumor size. Adrenal imaging (computed tomography, magnetic resonance imaging, metaiodobenzylguanidine, and 6-iodomethyl 19-norcholesterol I 131) characteristics (high attenuation, irregularity, heterogeneity, signal intensity, etc) may be helpful in distinguishing myelolipoma, simple adrenal cyst, phaeochromocytomas, hemangioma, hematoma, or hemorrhage. However, they are not accurate enough to diagnose or to exclude primary adrenal cancers or metastasis preoperatively. Fine-needle aspiration cytologic study to diagnose adrenocortical carcinoma has a low sensitivity, but it is more accurate for the diagnosis of adrenal metastasis. Unfortunately, this technique risks tumor capsule disruption and tumor cell spillage and dissemination along the needle tract. As documented in our study cohort, we do not believe FNA cytologic study is accurate enough to be used to determine whether a primary adrenal tumor is malignant. Positron emission tomographic scanning accurately diagnosed a solitary melanoma adrenal metastasis in 1 patient and it may be useful to confirm isolated adrenal metastasis or to rule out a malignant primary adrenal tumor, but more studies evaluating its accuracy are necessary. Given that no reliable and accurate preoperative diagnostic test to confirm the diagnosis of a primary malignant adrenal tumor or an adrenal metastasis exists, it is difficult to determine when an open approach should be used. An initial laparoscopic approach can be used to establish the diagnosis with low morbidity and allows curative resection in most instances, as demonstrated in this study. Obviously, in patients who have local invasion requiring adjacent organ resection or vascular reconstruction, a laparoscopic approach should be converted to an open approach. The overall complication rate was 12.5%, which is higher than we previously observed for our entire cohort (5.1%). This is probably due to patient selection in this study.
Adrenocortical carcinoma is associated with a dismal prognosis and has a 5-year actuarial survival ranging from 16% to 60%. Even when patients have localized disease and have complete tumor resection, recurrences occur in at least two thirds of patients. The locoregional recurrence rate after laparoscopic adrenalectomy of primary adrenal cancer was 60% and occurred 1 to 2.5 years after resection. This recurrence rate is similar to that reported for patients who have had open adrenalectomy for adrenocortical carcinoma. Interestingly, none of the patients who had adrenocortical carcinoma recurrence were suspected to have a malignant tumor preoperatively. Given that no reliable preoperative diagnostic test is available to distinguish benign from malignant primary adrenal neoplasm, open adrenalectomy cannot be selectively used in such patients, even if one believes that laparoscopic adrenalectomy may be associated with a high local recurrence rate.

Adrenal metastases commonly occur in patients with cancers of the lung, kidney, gastrointestinal tract, breast, and melanoma. Rarely, patients may present with an isolated (solitary) adrenal metastasis. Several investigators have documented that aggressive surgical resection of adrenal metastasis, when done in patients with solitary, resectable disease and after a long disease-free interval, can result in prolonged patient survival (especially in patients with non–small cell lung cancer and renal cell carcinoma). The indications we used for a laparoscopic approach in the patients with suspected adrenal metastasis were as follows: (1) curative intent for solitary adrenal metastasis; (2) palliative intent for large, symptomatic, synchronous adrenal metastasis; and (3) diagnostic intent for suspected adrenal metastasis. Laparoscopic adrenal metastectomy in our cohort resulted in no locoregional failures at a mean follow-up of 3.3 years. The adrenal metastases on average were smaller and did not invade through the capsule of the adrenal gland. These factors, in addition to the aggressive nature of adrenocortical carcinoma, may explain the superior results of laparoscopic adrenalectomy for adrenal metastasis than those for primary adrenal cancers.

Even if an open approach to allow en bloc resection would be preferable in patients who have adrenocortical carcinoma, the diagnosis is not always certain in patients who present with an adrenal incidentaloma or Cushing syndrome. Using a criterion of adrenal tumor size would subject too many patients to an unnecessary open procedure. Although laparoscopic adrenalectomy for unsuspected adrenocortical carcinoma was associated with a high local recurrence rate, it is unclear at this time whether an open approach would have resulted in a lower recurrence rate. Laparoscopic adrenalectomy for adrenal metastasis was diagnostic and curative and, in a number of cases, avoided unnecessary adrenalectomy. Furthermore, laparoscopic adrenalectomy achieved negative-tumor margins in all cases. We believe a laparoscopic approach is reasonable for malignant adrenal neoplasm when a complete resection is technically feasible and if there is no evidence of local invasion. In addition, a nonpermeable retrieval bag must be used. In our experience, FNA cytologic examination is not accurate enough to evaluate the malignant potential of adrenal neoplasm.

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REFERENCES


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DISCUSSION

Edward H. Phillips, MD, Los Angeles, Calif: The authors have retrospectively reviewed their extensive experience with laparoscopic adrenalectomy and reported upon a subset of patients who were found to have primary or metastatic malignancies involving the adrenal gland. Their data suggest that, with utilization of appropriate laparoscopic technique, adrenalectomy can be performed in the presence of malignancy without compromise in locoregional control or survival. They show that the laparoscopic approach does not alter the outcome when performed for metastatic disease, and moreover affords the opportunity to evaluate suspicious glands that may not harbor malignancy.

I have several questions for the authors.

First, as they have pointed out, adrenal cortical cancers are uncommon tumors and have a dismal prognosis. Curative resection is rare. Of 6 patients with primary adrenal cancer, 4 were asymptomatic, and 2 presented with Cushing syndrome. Only 1 was suspected to have a malignant tumor preoperatively, and that patient underwent an open adrenalectomy after a diagnostic laparoscopy confirmed extensive local invasion. One patient wasn’t suspected to have a malignancy until it recurred. In total, 3 patients underwent a laparoscopic resection, and 3 of them, or 60%, had a locoregional recurrence, similar to published outcomes in open surgery. Did the 1 patient who had a preoperative FNA have a recurrence? Can an FNA adversely affect the outcome in the patients with cortical cancer and what are your recommendations regarding FNA in this subset of patients? Were there differences between the 3 patients with recurrence and the 2 without? Were the tumors that recurred larger at the time of the original exploration?

Next, the authors’ laparoscopic experience in 13 patients with adrenal metastasis is impressive. No locoregional recurrence occurred during a mean follow-up of 3.3 years. What is the role of preoperative FNA or core biopsy in this subset, since 4 of 6 patients had a positive FNA? Should it only be reserved for patients with bilateral or multiple-site disease who aren’t being resected for cure in the hopes of avoiding surgery? Also, 3 patients had a laparoscopic biopsy. Could you describe your technique? Specifically, did you perform a laparoscopically guided core biopsy, incisional, or excisional biopsy? I find it interesting that there were no malignant pheochromocytomas in your series. A percentage of pheos are malignant, although this may not be recognized until they recur, similar to your patient with the recurrent adrenal cortical tumor. Was an open approach used preferentially for these tumors if they were a certain size? Or is it correct to assume that laparoscopic adrenalectomy for pheochromocytomas is safe, since no recurrences were noted?

Finally, I think the authors made a critical point of which we must take note. When performing adrenal surgery, one never knows if malignancy is present. Every procedure should be performed with this in mind. Our experience has taught us that the lateral approach offers the widest and best exposure to the right and left upper quadrants. It is virtually impossible to see as widely through a posterior approach. The entire gland and its surrounding fat must be removed intact. Since adrenal tumors are particularly friable and fracture with little pressure, one must take care to avoid grasping the gland itself. Experience with the anatomy, the variation in the location of the adrenal vein(s), and gentle handling of the gland are of critical importance. If a “no touch” technique is ever needed, this is the time. Perhaps you could comment on the surgical approach and technical elements that your group recommends.

Theodore X. O’Connell, MD, Los Angeles: I have a few questions for the authors. First, you start off with that laparoscopic adrenalectomy is the procedure of choice over open. What are the data for this? Do you have any study comparing open adrenalectomy with laparoscopic adrenalectomy, especially open done by the posterior approach? Was this done in a randomized prospective fashion or using historical controls?

The second question relates to the metastatic tumors to the adrenals. What is the justification for doing this procedure on these patients? Even though it is laparoscopic, it is still an operation. Again, you get around this issue by stating local control, but what you are really after is curing the patient and certainly the biologics of most of the tumors that you describe, particularly the lung cancers, are never single metastases and not cured by metastatectomy. We know that in the liver, lung cancer never metastasizes as a single metastasis. There are always other metastases. So even though you can resect the liver, you’re not going to cure those patients. So is there a justification to say that these are truly curative when the biologics of that tumor say it is not? I would like to know what the long-term follow-up as far as other metastases shows in developing a cure, not just local control in these patients. The other question related to metastases: it is really justified in a person with a non-small-cell lung cancer or with an adrenal mass to do an adrenalectomy for staging? Aren’t there other ways to make this diagnosis, just its presence in this setting, or PET [positron emission tomographic] scans or FNA, etc, to know that this is a metastasis without doing a complete adrenalectomy?

Sherry Wren, MD, Stanford, Calif: I have 2 questions for the authors of this excellent paper, both relating to the metastatic group. What cancers are the best candidates for adrenalectomy based on your experience? Second, what guidelines, such as initial disease-free interval, response to chemotherapy, do you consider in your patient selection?

John Vetto, MD, Portland, Ore: The authors conclude with some chagrin that FNA was not by itself predictive. But that is actually the case for FNA in many tumor sites, and what is often done for those other sites is to combine the FNA results with radiographic and clinical features to put together a prognostic package. For example, such an approach is currently popular in evaluating EUS [endoscopic ultrasonography]–FNA of the pancreas. So, I would ask the authors whether, with more data, they think that they can put together a predictive package that will make FNA more useful.

Lawrence Danto, MD, Stockton, Calif: This was an excellent paper, an excellent presentation. This may be just rephrasing a question that has been asked before, but with the increasing use and popularity of laparoscopic adrenalectomy, would you list the contraindications to this approach as you currently view them? Thank you.

Fred W. Grannis, Jr, MD, Duarte, Calif: I congratulate the authors on this nice study. As a lung cancer surgeon I personally do not have a 5-year survival for resection of a metastatic adrenal cancer, but we certainly do have a number of patients who are long-term survivors after resection of brain metastases. I will look forward to the long-term results of this study. It is good to know that isolated adrenal metastases can now be addressed effectively with minimally invasive techniques, and I applaud the authors for doing so.

Dr Duh: I will start with Dr Phillips’ questions. First of all, regarding whether FNA was done in patients with primary adrenal cancer who recurred: the only one patient in this group who had a fine-needle biopsy had a false-negative biopsy (misdiagnosed a cortical carcinoma as a benign oncocytoma), and he had local recurrence.

Regarding our recommendations for fine-needle biopsy for adrenal tumors, it is important to know why we do the fine-needle biopsy at all. Sometimes the first reaction for a radiologist seeing an adrenal mass is to recommend a needle biopsy.
We try to resist that temptation. We teach our residents to almost always needle biopsy a thyroid nodule, but almost never needle biopsy an adrenal mass. We do not routinely biopsy adrenal tumors for 4 reasons. (1) For primary adrenal neoplasms, the pathologist cannot distinguish between malignant and benign tumors. (2) The false-negative rate is high. (3) It is potentially dangerous unless pheochromocytoma has already been excluded. (4) Needle biopsy can cause bleeding and adhesion of adrenal gland to the surrounding tissues, making the subsequent dissection somewhat more difficult, and may contribute to tumor seeding and local recurrence. The only indication for fine-needle biopsy is when the results will change the patient’s treatment; for example, if the adrenal tumor is likely a metastasis, but we cannot or do not wish to remove it, and other treatments, such as chemotherapy or external radiation, will be used if the biopsy is positive.

A related issue is using laparoscopic adrenalectomy as a means of diagnosis. Most of these patients can go home after a day or two with minimal morbidity, and laparoscopy is sometimes the least invasive and most definitive diagnostic test compared with others. Most patients in this category had a negative FNA, but high clinical suspicion.

Regarding the size of the adrenal cortical cancers, 2 patients with tumors smaller than 4 cm resected. One was a woman with a 3.5-cm tumor that was initially resected by us. She had recurrent Cushing syndrome a year and a half later and was reoperated on laparoscopically elsewhere. She subsequently developed metastases and died. The pathology of the tumor removed at first operation was called benign, even when it was rereviewed in retrospect. We have to assume that the initial tumor was malignant, since the pathology of the tumor from the second operation was malignant and the tumor recurred both locally and systemically. This is another example that sometimes it is very difficult to tell whether an adrenal cortical tumor or a pheochromocytoma is benign or malignant.

Regarding pheochromocytoma, we have a selection bias in this series, since we do not choose to operate laparoscopically on those adrenal tumors that are obviously malignant with systemic metastases or have obvious local invasion such as renal vein involvement. In our experience of about 40 laparoscopic adrenalectomies for pheochromocytomas, none has turned out to be malignant so far. One recurrence was successfully reoperated on laparoscopically. This was not a cancer, however, but likely from tissue that was missed because the patient was initially operated on emergently in pheo-crisis after hemorrhage into the tumor.

Regarding the techniques of laparoscopic adrenalectomy, I agree with Dr Phillips that the lateral approach can afford you a much better view, and it is the approach that I prefer now, although we did have patients whom we approached posteriorly in this series. It is important to remove the whole adrenal gland and to include the peridrenal tissues, clearing down to the muscles in the back and the kidney laterally, and the vena cava and the liver on the right side. With few exceptions, we treat every adrenalectomy as a potential cancer operation.

Dr O’Connell, there have been no randomized studies comparing open vs laparoscopic adrenalectomy, and it is extremely unlikely that we will have one, since there are many retrospective and prospective, well-controlled, but nonrandomized studies showing dramatic differences in morbidity (pain, hospitalization, etc). One exception may be to study whether a solitary metastasis should be resected at all and whether it is best to resect it open or laparoscopically. But even in this area, it will be difficult to recruit patients, now that we have laparoscopic adrenalectomy as an option.

Regarding justification of resecting solitary adrenal metastasis, again I think it is relatively controversial. Unless we have a prospective randomized study, we cannot tell whether these patients would have lived just as long anyway regardless of having the solitary adrenal metastasis resected, or that they have benefited from the resection similar to colon cancer patients who undergo liver or lung resection for solitary metastasis. Regarding cancer staging, we agree that FNA is useful and adrenalectomy is not routine. The patients whom we operated on for staging had needle biopsy that was negative; most were false negatives. If the FNA were positive and one does not wish to resect a solitary metastasis, then laparoscopy would not be necessary.

Dr Wren, regarding the kinds of metastases to the adrenal that we resect, the classic ones are the non–small cell lung cancers, renal cell carcinomas, and melanomas. Again it is difficult to prove that we improve the long-term prognosis of these patients, but we have shown that it is relatively safe to do laparoscopic adrenalectomy in these patients.

Dr Vetto, regarding fine-needle biopsy, again, my major concern is that sometimes radiologists will do a fine-needle biopsy at the time they find an adrenal tumor, without ruling out pheochromocytoma. In our own series of pheochromocytomas, about 40% present as incidentalomas and of those half had needle biopsies; it is not necessary and can be dangerous. We don’t see those that don’t survive their needle biopsies.

Dr Danto, regarding contraindications, yes, there are contraindications to laparoscopic adrenalectomy. The 2 main ones are large size and obvious local invasion. Both are basically technical issues; they are challenging whether we resect them open or laparoscopically. Larger tumors are more difficult to expose and resect; locally invasive cancers may require radical resection of neighboring organs.

Sometimes people think of laparoscopic adrenalectomy as a totally different operation. It really isn’t. It is just part of the spectrum of the different operations that we can do to remove adrenal tumors, just as some large invasive adrenal tumors may require a thoracoabdominal incision, but others may only need an anterior or lateral abdominal incision or even a posterior incision. Each approach has its potential advantages and disadvantages. To argue that all adrenal tumors suspected for cancer should be resected by open technique would be just as ridiculous as to argue that all adrenal tumors suspected for cancer should be resected by a thoracoabdominal incision. It is all a matter of using the proper technique to completely resect the tumor. You can start laparoscopically, if the tumor is relatively small and you don’t see obvious local invasion in the preoperative studies. If you cannot do the operation safely laparoscopically, you can convert to a hand-assisted laparoscopic procedure using a 7–8-cm incision, and I have done that several times. If hand-assisted still won’t work, you can convert it to a completely open procedure. There is nothing in doing laparoscopic adrenalectomy that prevents you from conversion to open. If you do not think laparoscopy is safe for the patient, you should go ahead and convert the operation to open.