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Laparoscopic adrenalectomies: History, current trends, controversial topics, and surgical technique

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History and current trends

Although the adrenal gland was first described by Italian anatomist Bartholomaeus Eustachius in 1552, it took more than 350 years until the first adrenalectomy was carried out in 1889 by a Scottish surgeon, John Kowsley Thornton.¹⁻³ He removed a large tumor weighing 20 lb from a 35-year-old woman suffering from hirsutism.³ In 1926, the first pheochromocytoma was removed by Charles Mayo utilizing a flank approach.⁴ However, it was not until 1992, shortly after the advent of laparoscopic surgery, that the first laparoscopic adrenalectomy was performed by Dr. Joseph Petelin in Kansas City.^{5,6} It was at his first international minimal ac-

cess surgery symposium in Kansas City that he showed a video of a laparoscopic left adrenalectomy that he performed through a retrocolic window with the patient in a supine position.^{5,6} This video demonstrated the feasibility of the laparoscopic approach to adrenalectomy for the first time. In 1992, Gagner et al. reported three cases of laparoscopic adrenalectomy performed with trocars placed transabdominally in a subcostal position but with the patient in a full lateral position.⁷ In his report, he performed a unilateral left, and a bilateral adrenalectomy in 2 patients with Cushing's syndrome, and a unilateral left adrenalectomy in one patient with pheochromocytoma.⁸ Gagner et al went on to popularize

the lateral approach to the adrenal gland, and this technique is currently the most utilized approach around the world. In 1993, Walz et al. described the posterior retroperitoneal approach which has also become quite popular in some parts of the world.⁹

Over time, the laparoscopic approach has become widely accepted as the gold standard for adrenalectomy.¹⁰ In the beginning, however, there were concerns regarding the safety of the laparoscopic approach, its feasibility relative to tumor size, pheochromocytoma as the indication for surgery, and underlying malignancy. Early on, we sought to address these issues by comparing our single institution experience of nineteen consecutive open adrenalectomies to the subsequent forty-five consecutive laparoscopic adrenalectomies following the advent of the laparoscopic approach at our institution. There was a clear-cut benefit in terms of operating time, blood loss, time to regular diet, and length of stay in our study, favoring the laparoscopic approach.¹¹ We also analyzed our experience with laparoscopic adrenalectomy for large adrenal masses. We published a series of twenty-four consecutive large adrenal lesions measuring 5 to 11 cm in diameter with a mean size of 6.8 cm.¹² We found results comparable to the removal of smaller lesions with no conversions, no transfusions, and no major morbidity or mortality in our series.¹² In order to determine if these same favorable results could be attained nationally, we performed an analysis of the National Inpatient Survey database which collects data from approximately 20% of U.S hospitals. From the time period of 1998-2006 we looked at the results of open adrenalectomy compared to laparoscopic adrenalectomy from that database. We noted that there were fewer complications, lower mortality and a decreased length of stay associated with the laparoscopic approach. We also noted in this study that, as a byproduct of the laparoscopic approach, more adrenalectomies were being performed over that period of time; this suggests that more patients were willing to be subjected to surgery related to a minimally invasive approach, and that the size criteria for resection were gradually being liberalized.¹³ The safety and efficacy of laparoscopic adrenalectomy for benign tumors at this point in time is well established.^{10,14}

Safety concerns also existed in the beginning of the laparoscopic era regarding the laparoscopic resection of pheochromocytoma. In a three institution study involving 80 patients, we were able to demonstrate that adrenalectomy for pheochromocytoma was safe with

no conversions to open surgery, a mean length of stay of 2.3 days, no blood transfusions, and no recurrence of endocrinopathy with a mean follow up of 21 months.¹⁵ Our early findings have been replicated many times and a recent meta-analysis comparing open versus laparoscopic adrenalectomy has concluded that the operation is a safe and superior treatment option for pheochromocytoma with less blood loss and a lower length of stay.¹⁶

At this point in time, laparoscopic adrenalectomy should be the approach of choice for all benign adrenal lesions.^{10,14} Although the feasibility and safety of laparoscopic adrenalectomy for tumors >5 cm or pheochromocytoma was uncertain early on, laparoscopic resection is now routine.^{12,17} Nevertheless, it must be remembered that even in experienced hands, large solid lesions greater than 12 cm in diameter are technically challenging and may have a greater likelihood of conversion, or may require an open approach. This is less true for myelolipomas which can be very large, sometimes greater than 12 cm, however, they are soft, are easily manipulated, and often shell out of the retroperitoneum.

Laparoscopic adrenalectomy can be performed during pregnancy for primary aldosteronism, pheochromocytoma, and Cushing syndrome, although this subgroup of patients must be managed in a multi-disciplinary fashion and only with an experienced surgeon in laparoscopic adrenalectomy.¹⁸⁻²¹ Laparoscopic adrenalectomy may also be carried out for isolated adrenal metastasis.²² Caution should be exercised for primary adrenal malignancy, and should only be considered if it is contained to the adrenal gland (stages I and II).²³⁻²⁵ If there is extension beyond the capsule, wide en-bloc resection is required, and an open approach should be carried out.²³ When a laparoscopic approach is entertained for a cancer diagnosis, it should only be carried out by a surgeon very experienced in the laparoscopic approach to the adrenal gland.

Controversial topics

Laparoscopic adrenalectomy in malignancy

Since the first description of laparoscopic adrenal-ectomy, open adrenalectomy was preferred in the case of possible or confirmed malignancy. However, with increased expertise, it is an option to consider in selected cases. Certainly, in the event of a solitary metastatic lesion, it may be an option (e.g. lung, renal cell).^{22,26} In this case, management of tumor burden is the desired outcome. However, with primary cancers such as adre-

nal cortical carcinoma the utilization of a laparoscopic approach must be based on highly selective criteria.²³⁻²⁵ Tumor size, local invasion, may all preclude safe resection. These tumors tend to be firm and the adjacent tissue stiff and thickened, and utilizing rigid and small-bore laparoscopic instruments can increase the risk of capsular disruption which may lead to local recurrence and a worse prognosis.²⁴ Therefore, laparoscopic resection should only be undertaken for smaller tumors, without any evidence of invasion, and by an experienced surgeon in laparoscopic adrenalectomy. Under these circumstances, the operation may be attempted laparoscopically, but with a very low threshold for conversion. Conversion may be necessary to obtain adequate margins and to prevent capsular disruption.

In a recent meta-analysis, Hu et al. found that while the minimally invasive approach was associated with less blood loss and a shorter length of stay, those patients were also more likely to have early recurrence, and positive surgical margins or peritoneal recurrence. However, the overall mortality rates were similar.²³ These findings should give one pause. The current NCCN guidelines still recommend open adrenalectomy for adrenal tumors with a high risk of malignancy due to this high risk of local or peritoneal recurrence in laparoscopic adrenalectomy.¹⁴

Partial adrenalectomy

In the vast majority of patients with isolated tumors of the adrenal gland, complete resection of the adrenal gland should be carried out. Although the possibility of a tumor at a later point in time in the contralateral gland exists, that risk is small. If that were to eventually occur, then a partial adrenalectomy could be contemplated for that gland if it was technically possible, the rationale being to retain some adrenal gland function. However, there are circumstances where retaining adrenal tissue even with the first resection would make sense. Such an exception is MEN2A syndrome which carries a high risk of bilateral disease with the patient developing bilateral pheochromocytomas in 50% of patients.¹⁴ In that particular circumstance, even if the patient appears at the time of surgery to have unilateral disease, I would consider carrying out a partial adrenalectomy if technically possible. This approach has been supported by Nagaraja et al. in a meta-analysis of bilateral adrenal tumors and hereditary syndromes.²⁷ The main reason I do not favor routine partial adrenalectomy is that it is unnecessary since most

patients will have a normal contralateral adrenal gland that will never be diseased over their lifetime, and that subsequent laparoscopic reoperation of a previously partially resected gland if that became necessary would be extremely challenging with a high complication rate and a significant risk of conversion to open surgery. This risk would seem to me to be unacceptable if you have a normal adrenal gland on the opposite side.

Surgical approaches

There are three main approaches that have been described for laparoscopic adrenalectomy. At first, a transperitoneal approach with the patient in a supine position seemed to be the most logical for laparoscopic surgeons at the beginning of laparoscopic era because it replicated our approach to the abdomen for other conditions. However, the idea of performing a transperitoneal approach with the patient in a full lateral position made the operation far easier. In the full lateral approach, the spleen on the left-hand side and the liver on the right-hand side fall away from the retroperitoneum after appropriate mobilization. By comparison, in the supine approach, it is very difficult to elevate, mobilize and then subsequently retract those same structures and the degree of difficulty performing adrenalectomy is significantly greater. The laparoscopic retroperitoneal approach which has been popularized by Walz et al.⁹ and is also quite straight forward once the technique is mastered. However, there are limitations with respect to tumor size with that approach. A recent Cochrane review of five randomized controlled trials with a total of 244 patients did not show any significant difference between the transperitoneal lateral and the retroperitoneal posterior approaches.²⁸

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