Laparoscopic adrenalectomy – a review of initial 24 consecutive patients

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Abstract

Aim To analyze patient demographics, pathology, surgical procedure and outcome in initial 24 consecutive patients who underwent laparoscopic adrenalectomy in our department.

Methods Twenty four patients underwent laparoscopic adrenalectomy between September 2000 and August 2005. There were 12 males and 12 females with a mean age of 44.6 years (range 25–68 years). The indications for adrenalectomy were pheochromocytoma (13 patients), Cushing's syndrome (5 patients), myelolipoma (2 patients), adrenal cyst (2 patients), aldosteronoma (1 patient) and adrenal incidentaloma (1 patient). Nineteen of our patients with functioning adrenal tumours were prepared preoperatively for periods ranging up to 2 weeks by the endocrinologist. All laparoscopic adrenalectomies were performed via lateral transperitoneal approach using standard four-port

technique. Patients with pheochromocytoma and Cushing's syndrome were monitored in the surgical intensive care unit during immediate postoperative period. The clinical and intraoperative characteristics, complications and outcomes of all patients were analyzed.

Results The mean operative time for laparoscopic adrenalectomy was 136 minutes. Intraoperative hypertension occurred in 8 patients. Intraoperative hypotension occurred in 2 patients. One patient required conversion due to dense adhesions and hemorrhage. Postoperative complications were seen in six patients – immediate postoperative hypotension (2 patients), features of steroid withdrawal (2 patients) and postoperative pyrexia (2 patients). Five patients with pheochromocytoma required antihypertensive drugs in the postoperative period. There was no mortality in our series.

Conclusions Laparoscopic adrenalectomy is a safe operation that incorporates all the benefits of minimal access surgery and is associated with a satisfactory postoperative outcome . A careful preoperative preparation in functioning adrenal tumours aids in the faster recovery of these patients.

Keywords Laparoscopy · Adrenalectomy · Pheochromocytoma.

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Introduction

Since Gagner first described laparoscopic adrenalectomy in 1992; it has become the preferred method for removal of most adrenal tumours [1]. Many studies in the last decade have reported its safety and efficacy [2–4]. Several studies have compared the results of laparoscopic and open adrenalectomy, however only few controlled studies are

available [5, 6]. Randomized controlled trials comparing laparoscopic to conventional open surgery may be difficult in the present era since both patients and surgeons are inclined to adopt a minimal access surgical approach, wherever the facilities are available.

Initially, laparoscopic adrenalectomy was performed with transperitoneal approach, but further technical development and expertise led to several other transperitoneal and retroperitoneal approaches. This paper reviews our experience with laparoscopic adrenalectomy performed through the lateral transperitoneal approach.

Materials and Methods

The study population comprised initial twenty-four consecutive patients who underwent laparoscopic unilateral adrenalectomy. Thirteen patients had a right side adrenal tumour and eleven patients had a left side adrenal tumour. The indications for adrenalectomy were pheochromocytoma (13 patients), Cushing's syndrome (5 patients) secondary to adrenal adenoma, myelolipoma (2 patients) – one patient had abdominal pain in left upper quadrant, the second patient had a 8 cm x 5.5 cm tumour, adrenal cyst (2 patients), aldosteronoma (1 patient) and incidentaloma (1 patient) – detected in a patient with vasculitis. Altogether the study involved twelve males and twelve females with a mean age of 44.6 years (range 25–68 years). The mean tumour size was 4.8 cm (range 2–11.5 cm). Uncontrolled hypertension was the main presenting feature in six patients with pheochromocytoma. Headache was the predominant symptom in four patients. Abdominal pain and breathlessness were the presenting symptoms in two patients. One of our patients was diagnosed to have a multifocal hepatocellular carcinoma and left side pheochromocytoma while being evaluated for weakness and abdominal pain. The Positron emission tomography showed features of a benign adrenal tumour. She was advised laparoscopic adrenalectomy prior to the liver transplant. The presenting complaints in the patients with Cushing's syndrome included facial puffiness, weight gain, pedal edema and breathlessness. The presenting features in the patient with aldosteronoma were hypertension and paresthesia. Abdominal pain was the presenting feature in the patients with adrenal cyst.

All patients were evaluated for their demographics, including age, gender, operative indications, tumour characteristics, operative time, blood loss, intra-operative hypotension / hypertension, post operative outcomes, complications, length of stay, ambulation, oral intake and response to therapy.

Pre-operative preparation

A complete history (including family history) was elicited and a physical examination was performed in all these

patients. Routine hematological and biochemical examination were performed to assess fitness for surgery. A 24-hour urinary vanillyl mandelic acid / metanephrines and urinary free cortisol, plasma aldosterone, serum cortisol were requested based on the clinical presentation. Besides this, serum calcium and calcitonin levels were obtained for all patients to rule out multiple endocrine neoplasia. Radiological investigations including x-ray chest, abdominal ultrasonography (USG), abdominal computed tomography scan (CT) / magnetic resonance imaging (MRI) were performed. Our endocrinologist prepared nineteen of our patients with functioning adrenal tumour preoperatively. The preoperative preparation for thirteen patients with pheochromocytoma extended for periods ranging up to 2 weeks. Preparation consisted of alpha-adrenergic receptor blockade, beta 1 -adrenergic receptor blockade and preoperative intravascular volume expansion with crystalloids. Alpha-adrenergic receptor blockade included Prazosin (slow release 5–60 mg, titrated as per blood pressure) for 5–10 days, followed by beta 1 – adrenergic receptor blockade with atenolol (50–200 mg) for 1–2 days. Volume loading included intravenous normal saline 1.5–2 liters per day started 48 hours prior to the surgery. Normalization of blood pressure was defined as a resting blood pressure lower than 160/90 mm Hg.

Intra-operative Management

All the procedures were performed under general anaesthesia using a lateral transperitoneal approach. An arterial line for continuous intra-operative blood pressure monitoring and triple lumen central venous catheter was inserted in all patients at induction. All patients were catheterized and had an orogastric tube for stomach decompression which was removed in the immediate postoperative period except in three patients in whom a nasogastric tube was left in situ and removed in the post operative period.

Intra-operative hypotension was defined as a systolic blood pressure lower than 90 mm Hg and hypertension was defined as a systolic blood pressure higher than 170 mm Hg. Intravenous fluids were administered according to the central venous pressure. Intra-operative hypertension was managed with a combination of intravenous vasodilator (Nitroglycerin) and short acting beta blockers (esmolol) with transient cessation of tumour dissection, abdominal desufflation or both. A continuous infusion of muscle relaxants (atracurium) and analgesia (fentanyl) was used to maintain a uniform depth of anaesthesia. Once adrenal vein was ligated, nitroglycerin infusion was discontinued and inotropes were started whenever required.

Operative technique

All adrenalectomies were performed via a lateral transperitoneal laparoscopic approach using four or five ports. Standard 5 mm and 10 mm laparoscopic instruments were used

with 10 mm 30 degree telescope. Right-sided adrenal glands were identified after the retraction of liver. While dissecting the right-sided tumours the inferior vena cava was identified early in the procedure and safeguarded. The connective tissue between the medial border of the adrenal and the vena cava was carefully dissected. The right adrenal vein, which is shorter, was identified early in the dissection, clipped and divided (Fig. 1). Throughout the dissection effort was taken not to grasp the gland directly and orientation regarding the vena cava's location was always maintained.

On the left side the dissection was started by dividing the splenocolic and splenorenal ligaments. This enabled a full medial rotation of the spleen. The adrenal was identified, its borders defined and then the adrenal vein was dissected (Fig. 2). Special care was taken to avoid injury to the spleen and pancreatic tail. Control of exceptionally large capsular vessels and adrenal vein was obtained with clips; other minor vessels were divided with the help of ultrasonic harmonic scalpel. In all patients the specimen was placed in an impervious extraction bag and removed.

Postoperative management

Patients with pheochromocytoma and Cushing's syndrome were electively shifted to surgical intensive care unit for im-

mediate postoperative monitoring. Post-operative fluctuations of blood pressure and requirement of antihypertensive medication and analgesics were documented.

Data was collected in a retrospective fashion in all patients by review of the medical records and operative notes. The operative time was calculated from the time of initial skin incision to completion of skin closure, estimated blood loss was obtained from anaesthesia record and length of stay was defined by the number of days in the hospital after the operative procedure.

Results

The mean operative time in all patients was 136 minutes (range 96–300 min). The mean estimated blood loss was 250 ml (range 150–1000 ml). Two patients required blood transfusion. The first patient with a right side pheochromocytoma required two units of blood transfusion, as it was a very vascular tumour with more than 500 ml blood loss. The second patient with a left adrenal adenoma had more than one-litre blood loss. The patient was converted due to dense adhesions between adrenal gland and tail of pancreas and spleen. There was an injury to the pancreatic tail in the same patient.

Fig. 1 Right adrenal vein – clipped and divided

Fig. 2 Left adrenal gland with adrenal vein isolated

Intra-operative hypertension occurred in 8 patients (30%). All were controlled with intravenous vasodilators and transient cessation of tumour manipulation. Intra-operative hypotension occurred in two patients (one due to blood loss in a patient with Cushing's syndrome, the second was in a patient with pheochromocytoma). None of our patients had ventricular arrhythmias.

In all patients orogastric tube was placed at the time of induction of anaesthesia and was removed after reversal except in three patients, one of whom had a suspected vessel needle injury to stomach, the second patient who had conversion to open surgery and in the third patient for immediate post operative hypotension.

Postoperative characteristics

The mean duration of drain was 3.1 days (range 2–21 days). The mean duration for ambulation was 1.2 days (range 0–3 days). The mean duration of postoperative injectable analgesic requirement was 2.2 days (range 1–4). In all patients liquid diet was initiated on postoperative day 1 except for three patients who had nasogastric tube in postoperative period.

The mean length of stay of the patient in the hospital was 3.7 days (range 1–30 days). Five patients were discharged on postoperative day one. Two patients developed fever in

the postoperative period lasting for 2 days. Postoperative hypotension was noticed in two patients (one with a pheochromocytoma, the second patient had an adrenal cyst.) They were managed in the intensive care unit in the immediate postoperative period after a surgical cause was excluded. Two patients of Cushing's syndrome had features of steroid withdrawal. They were treated with steroid replacement. One of these patients developed confusion and altered sensorium and pedal edema due to electrolyte imbalance and hypoproteinemia respectively. This patient had the longest hospital stay in our series i.e. 30 days. Five patients with pheochromocytoma required anti hypertensive treatment post operatively but in all of them blood pressure was well controlled with anti hypertensive drugs. The endocrinologist was involved in the post operative care of all our patients with pheochromocytoma and Cushing's syndrome. The patient with pheochromocytoma and multifocal hepatocellular carcinoma subsequently underwent a liver transplant.

Histopathological evaluation revealed pheochromocytoma (13 patients), cortical adenoma (5 patients), aldosterone secreting adenoma (1 patient), myelolipoma (2 patients) and adrenal cyst (2 patients). The patient with incidentaloma had cortical hypertrophy of adrenal gland with focal lymphocytic infiltration.

Discussion

Advances in minimally invasive surgery have made it possible to remove solid organs such as the adrenal gland laparoscopically [7]. The adrenal gland is particularly suitable for laparoscopic removal because of its small size and the benign nature of most adrenal tumours [8]. Laparoscopy represent a better approach to the adrenal than traditional open surgery, in which long incisions are required, complicated by postoperative pain, a long hospital stay and a high incidence of abdominal wall hernias [9]. As the surgical access to the glands causes more trauma than the actual dissection of the adrenal gland, laparoscopic adrenalectomy is significantly less morbid than open adrenalectomy.

Malignancy with tumour invasion of adjacent structures and lymph node metastasis constitute the only absolute contraindication to a laparoscopic approach [8]. Controversy exists over the maximum acceptable tumour size for laparoscopic adrenalectomy [10]. Barresi and Prinz did not recommend it for lesions more than 6–8 cm though masses up to 10–15 cm have been resected laparoscopically [7, 11, 12]. According to Gagner neoplastic potential rather than size is the crucial issue in deciding the choice of approach [2]. The biggest tumour we have operated so far was a 10.7 x 11.5 cm benign adrenal cyst.

Due to technical developments, increasing experience and the well-documented safety of laparoscopic adrenalectomy, the application of the laparoscopic approach has been expanded to include excision for adrenal cancer and laparoscopic partial adrenalectomy in certain patients [8, 11, 13]. Laparoscopic approach seems to yield good results for isolated adrenal metastasis from lung and renal carcinoma in experienced hands [14, 15].

Incidental adrenal masses, detected in 1% to 5% of abdominal computed tomography scans performed for other reasons are the most common adrenal lesion seen by surgeons currently [8]. Adrenalectomy is indicated for incidentalomas that are hyperfunctioning or that have size and imaging characteristics atypical for an adenoma, cyst or myelolipoma [8]. Some adrenal lesions such as myelolipomas are apparent by imaging and do not require removal unless they cause local symptoms or enlarge significantly during follow up. Adrenalectomy for adrenal cysts is indicated if patient has hemorrhaged into the cyst or the diagnosis is uncertain [16].

The laparoscopic approach to the adrenal may be either transabdominal or retroperitoneal. The transabdominal lateral flank approach developed by Gagner et al is the preferred method in most institutions [8]. A thorough preoperative preparation is required for functioning adrenal tumours regardless of the approach to minimize the risks of surgery and anaesthesia. Patients with pheochromocytoma should have pharmacological blockade with an alpha-adrenergic receptor blocking agent. The goal is to control hypertension, tachycardia and prevent hypertensive exacerbations.

Patients with Cushing's syndrome have atrophy of the contralateral gland and therefore require administration of corticosteroids perioperatively to prevent postoperative adrenal insufficiency. Patients with aldosteronomas benefit from preoperative spironolactone [16].

Intraoperative monitoring consists of an electrocardiogram, pulse oximetry and urinary catheter in all patients. Patients with pheochromocytoma should have an arterial line and central venous pressure line. Hypertensive exacerbations and ventricular arrhythmias are most likely to occur during anesthetic induction, creation of CO₂ pneumoperitoneum and during direct tumour manipulation [16]. These paroxysms are responsible for the morbidity and mortality in patients with pheochromocytoma [16]. Hence continuous invasive monitoring and pharmacological intervention by a skilled anaesthesia team is necessary to avoid substantial cardiovascular instability [17]. From the operative technique point of view avoiding excessive direct tumour manipulation and early clipping of adrenal vein can prevent the catecholamine surges [18].

In 1996 Gagner et al reported their experience with 23 laparoscopic adrenalectomies for pheochromocytoma. Intra-operative hypertension (systolic blood pressure, SBP > 200 mm Hg) occurred in 58% of patients and hypotension (SBP < 80 mm Hg) occurred in 53% of cases [19]. This compares favorably with open series reports of hypertensive episodes in as many as 75% of patients. In our series intra-operative hypertension (SBP > 170 mm Hg) occurred in 8 patients (30%) and hypotension (SBP < 90 mm Hg) occurred in 2 patients (8.3%). In 2000, Sprung J et al reported that intraoperative hypotension was less severe and the hypotensive episodes were less frequent and required fewer interventions with vasopressors in patients who underwent laparoscopic adrenalectomy for pheochromocytoma compared to open adrenalectomy patients [20].

Besides the potential problems with catecholamine liberation, the increased size, prominent vascularity and dense adherence of pheochromocytoma to surrounding structures increase the difficulty of excision of these tumours [8]. As a result both laparoscopic and open approaches to these tumours have been associated traditionally with higher complication rates than adrenalectomy for other indications [21]. Bleeding has been reported to be the most common reason for conversion to hand assisted or open adrenalectomy. The other reasons for conversion include excessive tumour adhesions to surrounding structures, malignant features and large tumour size [16, 22]. The mean conversion rate to open adrenalectomy from a combined series was 3.4% [8]. We had one conversion in a patient with adrenal adenoma due to dense adhesions between adrenal gland, tail of pancreas and spleen (conversion rate 4.1%). In an analysis of major institutional series the overall mortality rate was 0.4%. The complication rate was significantly lower in the laparoscopic series (10.9%) than in the open adrenalectomy series (25.2%) [8].

Table 1 Various published series on adrenalectomy

S. No.	Characteristics Documented	Our Series	Hobart MG (12) L	Hobart MG (12) O	Gagner M(2) L	Jacobsen NE(25) L	Jacobsen NE(25) O	Hazzan D(26) L	Hazzan D(26)O
1.	Duration of operation (minutes)	136 (6-300)	158	216	123	171	104	188	139
2.	Intraoperative blood loss (ml)	250(150-1000)	113	584	70	146	455	NA	NA
3.	Intraoperative hypertension	8pts (30%)	NA	NA	56%	NA	NA	NA	NA
4.	Intraoperative hypotension	2pts (8.3%)	NA	NA	52%	NA	NA	NA	NA
5.	Initiation of oral intake (days)	1.16 (liquids)	NA	NA	NA	1.1 (RD)	3.7 (RD)	2 (RD)	3.9(RD)
6.	Ambulation (days)	1.2	NA	NA	NA	NA	NA	NA	NA
7.	Postoperative complications	Major 16.6% Minor 8.3%	8.9%	50%	12%	NA	NA	16%	39%
8.	Hospital Stay(days)	3.7	1.5	7.7	3	2.2	5.4	4	7.5
9.	Conversion(%)	1pt (4.1)	2.2	-	3	NA	-	7	-

L – Laparoscopic series, O – Open Adrenalectomy series, NA – Data not available, RD – Regular diet.

In our study, the operative time, blood loss, complications and length of hospital stay compare favourably with those in other reports of laparoscopic and open adrenalectomy [2, 12, 23–26] Table 1. In our opinion, this was because of a combination of factors including adequate preoperative preparation, careful perioperative monitoring, skilled anesthetic intervention and most importantly increasing operative experience. As described by other authors, learning curve may play a significant role in improving the efficiency and safety of advanced laparoscopic procedures [27].

Conclusion

Laparoscopic adrenalectomy is a safe operation that incorporates all the benefits of minimal access surgery and is associated with satisfactory postoperative outcomes. A careful preoperative preparation, intensive perioperative monitoring, skilled anesthetic intervention and meticulous operative technique aids in the faster recovery of patients with functioning adrenal tumours.

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