



Original Article

Laparoscopic adrenalectomy: Experience in a tertiary care hospital in Eastern India

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ABSTRACT

Introduction: Laparoscopic adrenalectomy is considered the gold standard technique for the surgical removal of the diseased adrenal gland. We evaluate our experience in laparoscopic adrenalectomy with special emphasis on efficacy, safety and learning curve with this technique.

Materials and Methods: A total of 24 patients undergone lateral transperitoneal laparoscopic adrenalectomy for various adrenal disorder in our institution. Patient's demographics, tumor characteristics, operating times, surgical outcomes, complications, recovery and length of hospital stay were studied. All patients undergone through history and physical examinations. Investigations like ultrasound (USG) of whole abdomen, contrast enhanced computerized tomogram (CECT) of abdomen were done in every patient and magnetic resonance imaging in selected patients. Serum cortisol levels and 24 hours urinary free cortisol were estimated in every patient, and 24 hours fractionated urinary metanephrines, plasma free metanephrine, normetanephrines and /or Vanillyl mandelic acid (VMA) levels were performed selectively in suspected pheochromocytoma. Aldosterone to renin ratio (ARR), only in patients with hypertension or hypokalemia.

Results: Laparoscopic adrenalectomy was conducted in 24 patients of whom two patients needs open conversion due to uncontrolled intraoperative bleeding from right adrenal vein which was torn at its junction from inferior vena cava (IVC). The patients were in the age range of 22 to 67 years, Complications in post-operative periods occurred in four patients: one patient had lung atelectasis, one patient had wound infection, one patient had port site infection and one patient developed post-operative hypotension. All patients were managed conservatively. No patients had hepatic, renal, bowel, pancreatic or splenic injuries. Right sided adrenalectomies were nine and left sided adrenalectomies were fifteen. Mean operative time was 160 minutes and ranged from 130-200 minutes. Mean operative blood loss was 120 ml and ranged from 100-160 ml. Mean post-operative analgesic requirements for laparoscopic adrenalectomies were significantly less, with 50 mg tramadol hydrochloride twice daily for first 36 hours. Oral intake of fluid was given mostly six hours after operation and diet were given when oral liquid was tolerated after an average of two (1-3) days. Duration of hospital stay ranged from 3-5 days (median 2.5 days).

Conclusions: Laparoscopic adrenalectomy is a relatively easy, safe, cost- effective, less morbid procedure. Lateral transperitoneal approach offers advantages including better visibility and easy access to other abdominal organ system. Hence it becomes gold standard for most of the benign adrenal diseases and in some malignant tumors in hand of expert and experienced surgeons irrespective of size of the tumors.

Keywords: Laparoscopic adrenalectomy, transperitoneal, lesser morbidity

INTRODUCTION:

With widespread use of radiological imaging for unrelated abdominal conditions, there has been significant increase of adrenal incidentalomas. Adrenal incidentalomas are unsuspected adrenal masses > 1 cm in diameter identified on cross-sectional imaging performed for seemingly unrelated causes. Incidence of adrenal incidentalomas is about 5% (Song et al, 2008). The incidence of the incidental adrenal mass increases with age. Adrenal masses require a detailed evaluation because of their various clinical, laboratory and radiological presentations. Adrenal masses may be metabolically active or inactive; benign or malignant. More than ten percent (>10%) of adrenal incidentalomas are metabolically active. Adrenalectomy is recommended for masses that show malignant characteristics on imaging or for hormonally active masses. Masses that exceed 6 cm should be considered malignant until proven benign, which generally requires definite resection. Management of incidentalomas between 4-6 cm is more controversial as rate of malignancy is estimated to be only 6 %. Adrenalectomy is advocated adrenal mass 4 cm or larger and those mass grow over 1 cm or positive repeat functional work up. Removal of adrenal gland can be performed open, laparoscopic or robotic approach. Knowsly Thornton was credited with performing the first successful adrenal surgery in 1889 on a 36-year-old hirsute woman with a large abdominal mass (Thornton). Although Thornton was unaware of the adrenal origin of the patient's tumor. A 20 pound left adrenal malignant tumor was resected en bloc with her left kidney. The first planned open adrenalectomy was done by Sargent in 1914 for a large adrenal adenoma¹. The first adrenalectomy was performed via a T- shaped subcostal incision. In 1927 Charles Mayo performed the first flank adrenalectomy for a retroperitoneal nerve tumor diagnosed as pheochromocytoma (Mayo, 1927). But it requires a large flank incision which is causing greater morbidity specially in patients with morbid obesity with high body mass index (BMI). In 1932 Broster used a transpleural, transdiaphragmatic approach through a long, posterior intercostal incision, providing excellent access for adrenalectomy (Broster et al., 1932). In 1936 Young described a "hockey stick" posterior approach to access both adrenal glands simultaneously. The thoracoabdominal incision for large retroperitoneal masses was first described by Chute et al. (1949). The first laparoscopic tranperitoneal adrenalectomy was performed by Michel Gangner in 1992². In 1992 Gaur developed the first device for ballon dilatation of retroperitoneum, and in 1995 Mercan reported the first case of retroperitoneoscopic adrenalectomy. The first robot-assisted laparoscopic adrenalectomies were reported by Piazza et al. and Hubens et al. (1999). Since laparoscopic adrenalectomy has become the standard technique for the surgical removal of the adrenal gland in various centers worldwide. Laparoscopic approach has many potential benefits like, less morbidity, better cosmesis, reduction in wound infection, decreased requirement of postoperative analgesia, decreased hospital stay and early return to work³⁻⁵. Laparoscopic adrenalectomy can be performed via lateral transperitoneal, anterior transperitoneal and posterior retroperitoneal approaches. Each approach has its specific advantages and disadvantages⁶. Here we share our experience of laparoscopic adrenalectomies in our institution performed using lateral transperitoneal approach in 24 patients with various adrenal disorder. In this study various parameters, including demography, tumor characteristics, operative time, estimated blood loss, length of hospital stay, open conversion, outcomes, patient's satisfaction and complications, were analyzed.

Materials and Methods:

A total of 24 patients were undergone lateral transperitoneal laparoscopic adrenalectomy between December 2022 to October 2024 in our institution. Male patients were 9 and female patients were 15. 8 were right sided and 16 were left sided. The overall age was 35.8 years (range 22-67 years). The indications of surgery were cortisol secreting adenoma 3 patients, aldosterone secreting adenoma 1 patient, Cushing syndrome (macronodular adrenocortical hyperplasia) 2 patients, myelolipoma 11 (figure 1a) patients, pheochromocytoma 3 patients (figure 1b), adrenal cyst 4 patients. Laparoscopy was limited to well- encapsulated masses without radiologic periadrenal involvement or obvious lymphadenopathy. Exclusion criteria were tumor size large than 10 cm, suspicion of malignancy on contrast imaging, adrenal vein or vena caval involvement, extensive metastatic disease, uncontrolled coagulopathy, and cardiopulmonary disease that precludes anesthesia. All patients undergone through history and physical examinations. Investigations like ultrasound (USG) of whole abdomen, contrast enhanced computerized tomogram (CECT) of abdomen were done in every patient and magnetic resonance imaging in selected patients. Serum cortisol levels and 24 hours urinary free cortisol were estimated in every patients, and 24 hours fractionated urinary metanephrines, plasma free metanephrine, normetanephrines and /or Vanillyl mandelic acid(VMA) levels were performed selectively in suspected pheochromocytoma. Aldosterone to renin ratio (ARR), only in patients with hypertension or hypokalemia. Perioperative data are collected and analyzed. Correction of metabolic abnormalities in patients with Cushing syndrome and hyperaldosteronism, and control of pheochromocytoma-induced hypertension was achieved with α -adrenergic (phenoxybenzamine) and or β -adrenergic blockade (atenolol or metoprolol) and volume repletion before surgical intervention. A clear liquid diet and a mechanical bowel preparation were administered the day before surgery. Prophylactic intravenous third generation cephalosporin was administered 30 minutes before the induction of general anesthesia.

Operative technique

The transperitoneal lateral approach is appropriate for primary adrenal tumor with a diameter $\geq$ 6 cm because it provides a wide operating field and clearly exposes the adrenal gland. After general anesthesia, a urinary catheter and a nasogastric tube are inserted to decompress the bladder and the stomach. For left adrenal patient is positioned in the right

semi-lateral position (about 70 degree). The umbilical region was placed over the break in the operating table; table was flexed. An axillary roll was put to protect dependent brachial plexus. Extend the tumor side slightly, and place the left arm on an airplane-type arm board. Usually three ports were used in case of left adrenalectomy. After making a skin incision, a primary camera port 10 mm was placed about 3 cm lateral and cephalad to the umbilicus (lateral to rectus), using the closed method. Two working ports, 10 mm and 5 mm were placed in the midclavicular line, the upper one (5 mm) below the costal margin, and the lower one (10 mm), 10-12 cm below the upper one. A fourth 5 mm port, if required, was placed in the left mid-axillary line to facilitate the retraction. The spleen, splenic flexure, descending colon, and tail of pancreas require extensive mobilization to view the left adrenal gland. The splenic flexure and spleen were mobilized as a single unit. All splenic attachments to gerota's fascia, the abdominal sidewall and the diaphragm are released using harmonic scalpel or ligasure. The lateral splenic attachments were incised up to the level of the gastric fundus. The plane between the tail of the pancreas and gerota's fascia should be developed for the pancreas to fall away with the spleen. The colon was mobilized along the line of Toldt, with a release of the splenocolic and phrenocolic ligaments. Subsequently, the lienorenal ligament was incised. After incising the gerota fascia, the upper pole of the kidney was visualized. Dissection along the medial aspect of the kidney was continued till the left renal vein was identified. Next, dissection along the superior aspect of the renal vein was identified the left adrenal vein, which was clipped and divided. After controlling the adrenal vein, the superior aspect of the adrenal gland was mobilized and phrenic vessels supplying the gland were divided. The medial aspect of the adrenal gland was mobilized from the aorta and the vessels supplying the gland were divided using harmonic or ligaSure. Finally, the lateral attachments of the gland were divided, to free the gland fully from the surrounding tissue.

Right adrenal gland removal was usually performed with four ports. 5 mm sub-xiphisternal port was placed for liver retraction. A fifth 5 mm port, if required, was placed in the right anterior axillary line, to facilitate retraction. The right colon was mobilized along the line of Toldt. The liver was retracted with 5 mm sub-xiphisternal port using a fan like retractor. The triangular ligament and the anterior and posterior coronary ligaments were transected and the posterior peritoneum was incised along the surface of the liver, extending from the line of Toldt laterally, up to the inferior vena cava (IVC) medially. Next, the renal hilum was exposed after the mobilization of second portion of the duodenum medially. Hepatodiaphragmatic attachments were identified and dissected. The accessory hepatic veins were identified and preserved. Meticulous dissection along the lateral vena cava will allow identification of the right adrenal vein. The right adrenal vein entering into the posterolateral aspect of IVC was identified, isolated, clipped either with hem-o-lock clip or ligaclip and divided. Subsequently, numerous small superior and inferior adrenal vessels were coagulated and cut either with ligasure or harmonic scalpel. The lateral attachments of the gland were last to be divided, to free the gland fully from the surrounding tissue. These attachments were served to support the gland in a lateral and cephalic position.

Postoperative management

Electrolytes were checked at the night of surgery and every morning; this was especially important for the patients with Conn or Cushing syndrome. Catheter was usually removed on the first postoperative day when patient was ambulatory. If a nasogastric tube was placed; it can be removed after completion of surgery. Diet was usually allowed on the first postoperative day after return of bowel sound or when patient can tolerate diets. Vitals were continuously monitored. Unexplained hypotension, confusion, lethargy, nausea, vomiting, or fever could represent Addisonian crisis (adrenal insufficiency). Adrenal insufficiency is most commonly encountered after surgery for Cushing syndrome, because of contralateral cortisol suppression. Stress dose steroid administration may be necessary. Corticosteroid and mineralocorticoid (fludrocortisone) replacements may be necessary for life long.

Table 1 Patients characteristics for laparoscopic adrenalectomy

Characteristics	Numbers (%)
Number of Patients	24
Sex	
Male	9(37.5)
Female	15(62.5)
Age	35.8(22-67)
Side	
Right	8(33.3)
Left	16(66.7)

RESULTS

Laparoscopic adrenalectomy was conducted in 24 patients of whom two patients needs open conversion due to uncontrolled intraoperative bleeding from right adrenal vein which was torn at its junction from inferior vena cava (IVC). Complications in post-operative periods occurred in four patients: one patient had lung atelectasis, one patient had wound infection, one patient had port site infection and one patient developed post-operative hypotension. All patients were managed conservatively. No patients had hepatic, renal, bowel, pancreatic or splenic injuries. Right sided

adrenalectomies were nine and left sided adrenalectomies were fifteen. Mean operative time was 160 minutes and ranged from 130-200 minutes. Mean operative blood loss was 120 ml and ranged from 100-160 ml. Mean post-operative analgesic requirements for laparoscopic adrenalectomies were significantly less, with 50 mg tramadol hydrochloride twice daily for first 36 hours. Oral intake of fluid was given mostly six hours after operation and diet were given when oral liquid was tolerated after an average of two (1-3) days. Duration of hospital stay ranged from 3-5 days (median 2.5 days).

Table 2 Adrenal tumor characteristics

Histopathological diagnosis	Number of patients (%)	Mean tumor size(cm)
Myelolipoma	11(45.8%)	6.8
Cortisol secreting adenoma	3(12.5%)	3.6
Aldosterone secreting adenoma	1(4.2%)	3.2
Pheochromocytoma	3(12.5%)	5.8
Adrenocortical hyperplasia	2(8.3%)	3.4
Adrenal cyst	4(16.7%)	5.6

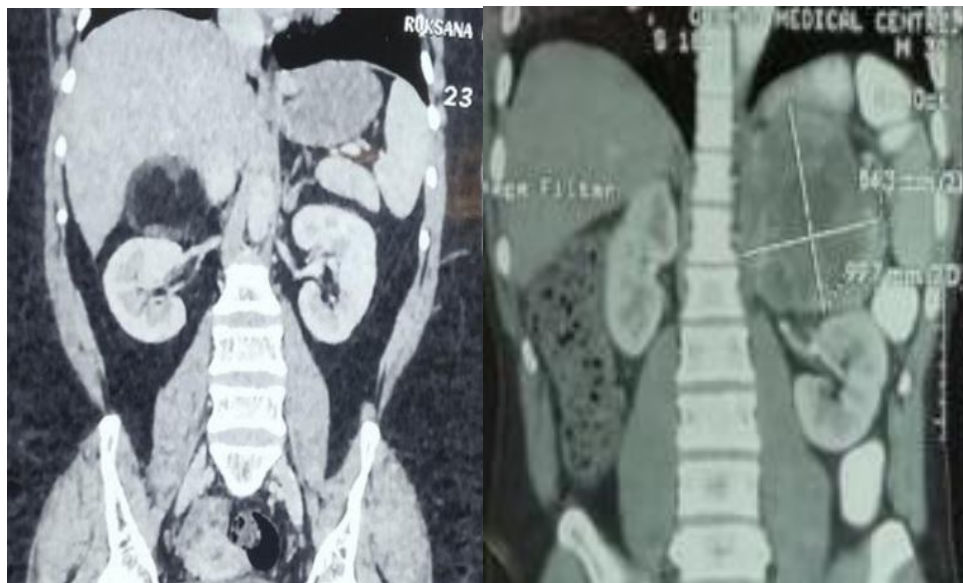


Figure 1a: CECT- showing right adrenal mass with negative soft tissue density (myelolipoma)

Figure 1b: CECT- showing large left adrenal mass displacing left kidney inferiorly



Figure 2 a and 2b: showing laparoscopic dissection of adrenal mass.

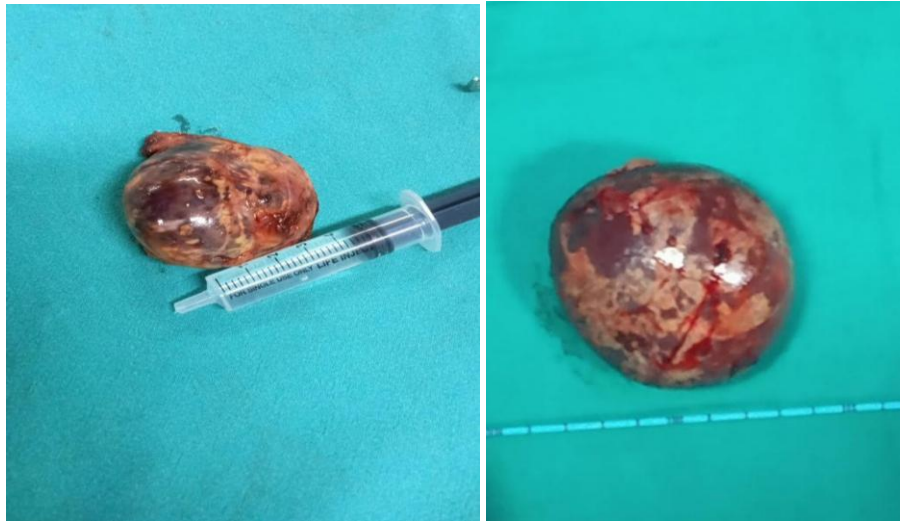


Figure 3 a and 3 b: Intact specimen of the 6 cm adrenal mass removed laparoscopically.

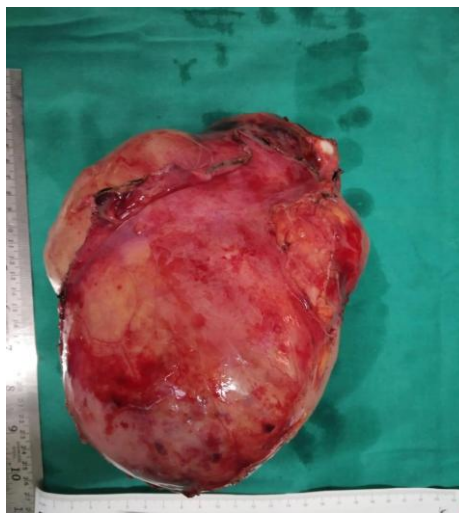


Figure 4: Large adrenal tumor about 10 cm removed laparoscopically.

DISCUSSION

Disorders of adrenal glands results in classic endocrine syndromes such as Cushing's syndrome, hyperaldosteronism, and catechol excess from pheochromocytoma. The diagnosis of these disorders requires careful endocrine evaluation and imaging with computed tomography (CT) or magnetic resonance imaging (MRI). Over the last decade, there has been slow paradigm shift from open adrenalectomy towards laparoscopic adrenalectomy. Laparoscopic adrenalectomy is replacing open adrenalectomy as the standard of care for surgical management of most adrenal lesions. With the advent of laparoscopic adrenal surgery, it becomes "gold standard" for removal of diseased adrenal gland. Indications of laparoscopic adrenalectomy are functional adrenal tumors (aldosterone/ cortisol secreting adenoma, bilateral adrenal hyperplasia, pheochromocytoma), symptomatic benign adrenal cyst or myelolipoma and small incidentaloma without clinical or radiologic evidence of malignancy and local invasion. Most of the incidentalomas are diagnosed as rampant use of radiological modalities like ultrasound, CT and MRI imaging in other abdominal conditions. Contraindications to laparoscopic adrenalectomy would be indications for open adrenalectomy. Absolute contraindications are local recurrence of a previously resected adrenal mass, invasive adrenocortical carcinoma with evidence of invasion of neighboring organs or renal vessel or vena caval involvement, extensive metastatic disease, uncorrected coagulopathy and severe cardiopulmonary disease. Oncologic principles of resection are no touch technique, preservation of the intact peritoneum on the anterior surface of the adrenal gland if no evidence of invasion through the overlying peritoneal layer, enbloc resection of tumor with a wide margin of surrounding benign tissue outside the tumor capsule, strict preservation of an intact tumor capsule. Although most laparoscopic surgeons are comfortable with tumor size up to 6 to 7 cm, there is no clear upper limit to the size at which laparoscopic surgery would be contraindicated. However, available literature seems to suggest an arbitrary upper limit of about 10-12 cm in diameter. MacGillivray and coworkers (2002) and Henry and colleagues (1999) recommended an upper size limit of 12 cm for laparoscopic adrenalectomy. Lau et al, (1999) stated that computed tomographic scanning can underestimate specimen size by as much as 16%. Perioperative medical management is essential for optimal surgical outcome for functional adrenal tumors. The advantages of laparoscopic

surgery are well exposure, easy control of its friable parenchyma and abundant vascularity and lesser morbidity. The literature review and data analysis provided objective evidence that minimally invasive techniques compare favorably with traditional open surgery in terms of safety, efficacy, patient outcome, reproducibility, and complications⁷⁻¹¹.

There are varieties of laparoscopic approaches to the adrenal glands have been described. Transperitoneal laparoscopic adrenalectomy can be performed through either an anterior supine approach or lateral approach. In general, the anterior supine approach allows bilateral adrenalectomy without having to reposition the patient. The lateral transperitoneal approach offers many advantages including improved visibility of familiar anatomic structures, greater working place and natural gravity assisted traction of the bowel, spleen and liver. Retroperitoneoscopic approach have several advantages for experienced retroperitoneoscopic surgeon, including reduced risk of visceral injury, less chance of development of paralytic ileus, and better exposure after previous intra-abdominal surgery with intra-abdominal adhesions.

Several reports reveal significant advantages for laparoscopic approach with regard to patient's satisfaction and comfort, hospital stay, and return to normal daily activities.¹²⁻¹⁵

The laparoscopic adrenalectomy can be employed in most patients with adrenal pathology, including cortisol-secreting adenomas, aldosterone-producing adenomas, pheochromocytomas and also functioning or non-functioning incidentalomas.

LIMITATIONS

It is important to acknowledge the limitations of our study. It includes single center design, relatively small sample size, and short follow-up period. The learning curve of laparoscopy may have influenced early results.

CONCLUSION

Laparoscopic adrenal removal surgery becomes the “gold standard” for both functioning and nonfunctioning benign adrenal tumors up to 10 cm of greatest dimension. Laparoscopic adrenal surgery also conducted in masses with no invasion of periadrenal tissue, adrenal vein and lymphadenopathy. Laparoscopic adrenalectomy is one of the best prototype of minimally invasive surgery where it prevents application of extirpative surgery in removal of diseased adrenal gland. It is safe, effective, useful and less morbid procedure with equal oncologic clearance in contrast with morbid open procedure. But thorough clinical, radiological and functional assessment along with preoperative optimization are require to perform the operation safely and preventing untoward effects in perioperative periods.

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