Academic Journal of Science and Technology,
JAN, 2023, vol.1, No.1, p. 109-113

Adrenalectomy in Libya: A Retrospective Study

Ala Wafa[1,2], Ali Shagan[1,2], Rawad Friwan[2], and Khaled Ben salah[3*]

1-Department of Surgery, Faculty of Medicine, Misurata University, Misurata, Libya.
2-Department of Surgery, National Cancer Institute, Misurata, Libya.
3-Department of Pathology, NCI Misrata, Misrata University.

ABSTRACT

Adrenal surgery for the treatment of adrenal disorders has not yet been the subject of a population-based study. The current study's objective is to assess the practice of adrenalectomy at the national cancer institute of Misrata and identify the advantages of laparoscopic adrenalectomy in comparison to open adrenalectomy. Methods: A retrospective study of 33 adrenal tumors that underwent surgical resection at Misurata Cancer Center from April 2013 up to January 2021. We compared: age, sex, marital status, past medical history, function and size of the tumor, type of surgery, duration of surgery, estimated blood loss, preparation of the patient for surgery, post-operative complications, post-operative discharge day, and mortality. Results: There were 33 adrenal tumors; 63.7% were females and 36.3% were males, with a median age of 41 years. 72.7% of hypertensive patients, 75.8% functional tumors and 24.2% nonfunctional tumors. 81.8% are benign tumors and 18.9% are malignant. Laparoscopic adrenalectomy was performed in 23 cases (69.7%), open adrenalectomy in 10 cases (30.3%), and the mortality rate was 3%. Conclusion: Surgical treatment of adrenal tumors consists of laparoscopic and open adrenalectomy. The type of surgery depends on the size of the tumor and the suspicion of malignancy in the imaging study. Laparoscopic adrenalectomy is safe and effective for benign tumors with decreased operative time, less post-operative pain, and a decreased hospital stay.

KEYWORDS: Laparoscopic adrenalectomy, Pheochromocytoma, functional adenoma.

1. INTRODUCTION

The adrenal glands are paired, positioned at the superomedial aspect of the kidney in retroperitoneal space; the right adrenal is flattened and pyramidal in shape, while the left is crescent-shaped, weighing about 4 g each (1). The right adrenal gland is positioned at the posterolateral surface of the retrohepatic vena cava, and its fossa is bounded inferolaterally by the right kidney, posteriorly by the diaphragm, and the liver anterosuperiorly. The left adrenal gland is positioned between the left kidney and aorta, and its fossa is bounded by the diaphragm posteriorly and the splenic hilum and the tail of the pancreas anteriorly. The arterial supply of the adrenal gland arises from three arteries: the superior adrenal artery from the inferior phrenic artery, the middle adrenal artery from the aorta, and the inferior adrenal artery from the renal artery. While the venous drainage of the adrenal gland is different on both sides, the left adrenal vein is 2cm long and drains into the left renal vein after joining the inferior phrenic vein, while the right adrenal vein is 0.5cm long and drains directly into the inferior vena cava. The adrenal gland consists of the adrenal cortex and medulla. The cortex has a high lipid content and accounts for about 80 to 90% of the gland volume. Histologically, the cortex is divided into 3 zones: the zona glomerulosa, fasciculata, and reticularis, which secrete aldosterone, glucocorticoids, and androgens. The adrenal medulla constitutes up to 10 to 20% of gland volume, secreting catecholamine hormones such as epinephrine and norepinephrine.

Indications for adrenalectomy depend on the size of the tumors and their function. The size equal to or greater than 4 cm is indicated for surgery, and the functioning tumor is indicated for surgery regardless of the size. Laparoscopic adrenalectomy is the gold standard treatment for both functioning and nonfunctioning benign adrenal tumors of less than 6cm in size (2). Open adrenalectomy is still the treatment of choice for malignant neoplasms of the adrenal gland (3). Laparoscopic adrenalectomy has many advantages, including a decreased length of hospital stay, reduced postoperative pain, and an early return to work (4). Laparoscopic adrenalectomies can be done by transabdominal or retroperitoneal approaches. The choice depends on the size of the tumor and the expertise of the surgeon (5). Open adrenalectomy can be done by an

* *Corresponding author: k.bensalah@nci.edu.ly*

anterior transabdominal approach via a long vertical midline incision or a long subcostal incision, or a posterior retroperitoneal approach via an incision at the bed of the 12th rib with the patient lying prone. Open surgery is associated with more pain, ileus, atelectasis, a longer period of recovery, and increased risks of poor wound healing, especially for patients with Cushing syndrome (6).

A functioning adenoma is an indication for adrenalectomy. Pheochromocytoma is a functional tumor of the adrenal medulla secreting catecholamines, causing symptoms of hypertension such as headache, palpitation, and diaphoresis. Conn's adenoma is a tumor of the adrenal cortex where Zona Glomerulosa secretes excess aldosterone, causing symptoms of hypertension, fatigability, and muscle weakness due to hypokalemia. Cushing adenoma is a tumor of the adrenal cortex where Zona Fasciculata secretes excess cortisol, causing symptoms of Cushing syndrome, truncal obesity, hirsutism, moon face, acne, striae, buffalo hump, hypertension, and diabetes (1).

Laboratory tests used to identify adrenal function, including tests for serum metanephrine and noremetaniphrine, are 99% sensitive and 89% specific, and 24-hour urine collection of catecholamines and their metabolites is 88% sensitive and 95% specific for pheochromocytoma (7). Conn's adenoma is diagnosed by a high serum aldosterone level, a high serum aldosterone/serum renin ratio, and a low serum potassium level (1). Cushing's adenoma is diagnosed by a high level of 24-hour urinary free cortisol, high serum cortisol, and low serum ACTH (8).

Radiological imaging is useful to reach the diagnosis of an adrenal lesion and distinguish between benign and malignant features (9). A contrast-enhanced CT scan is a useful imaging modality. The criteria for benign lesions are a size of 4cm, homogenous, well-defined borders, rapid washout of contrast, low vascularity, and a high level of intracellular lipids. The criteria for malignant lesions are size >6cm, heterogeneous, ill-defined borders, necrosis, calcification, and hemorrhage within the mass, high vascularity, and a low level of intracellular lipids (8).

From a histopathological point of view, adrenocortical tumors, adrenomedullary tumors, and metastases are three tumor types that are significant in the regular pathology of the adrenal glands. Structure-wise, it might be challenging to distinguish between these three basic tumor forms; however, immunostaining almost always makes a diagnosis possible. Adrenomedullary cancers express chromogranin A but never keratin, whereas adrenocortical tumors express steroidogenic factor 1, melanin-A, and are always negative for chromogranin A. For the detection of metastases and even the uncommon epithelioid angiosarcomas, a wide range of antibodies are available. Three scoring methods may be used to distinguish between adenomas and carcinomas in adrenocortical tumors, and the Ki-67 index in adenomas shouldn't be more than three percent. Approximately ninety percent of cortical tumors can be distinguished as benign or malignant using grading methods and the Ki-67 index. Two grading methods are used to distinguish between benign and malignant tumors in pheochromocytomas; however, the outcomes are less reliable (10). This study aims to assess the practice of adrenalectomy at the national cancer institute of Misrata and identify the advantages of laparoscopic adrenalectomy in comparison to open adrenalectomy in terms of operative time, postoperative pain, and hospital stay.

METHODS AND MATERIALS:

From April 2013 to January 2021, a series of adrenalectomies were performed at the Misurata Cancer Center, department of surgical oncology, Misurata, Libya. This study involved 33 patients with various adrenal tumors. Two types of surgery were used: transperitoneal laparoscopic and open adrenalectomies. The diagnosis was obtained on the basis of clinical examination, laboratory values, and imaging techniques (computed tomography and magnetic resonance imaging).

Patients evaluation included preoperative, intraoperative, and postoperative data. All patients underwent routine laboratory tests (complete blood count, urea, creatinine, sodium, potassium, and blood sugar), hormonal tests for adrenal function (serum metanephrine, serum noremetanephrine, serum aldosterone, serum renin, aldosterone-renin ratio, serum and urine cortisol), chest x-ray, ECG, and cardiological evaluation. Patients diagnosed with pheochromocytoma underwent an alpha blocker (Prazosin) for 7 to 10 days until blood pressure was controlled and the patient developed postural hypotension, then tachycardia was treated with a beta blocker (Propranolol) until the heart rate became less than 100 bpm. Also, plasma volume was expanded using crystalloid solutions. A patient diagnosed with Conn's adenoma with low serum potassium levels underwent potassium sparing diuretics (Spironolactone and potassium chloride) until serum potassium levels returned to normal.

Intraoperative management: All patients received general anesthesia, antithrombotic prophylaxis (Fraxiparine 2500 I.U. s.c.), and antibiotic prophylaxis (Ceftriaxone i.v.). In patients with pheochromocytoma, an arterial line is used for invasive intraoperative monitoring of blood pressure. Laparoscopic adrenalectomy, in which the patients are placed in a lateral position with an angle of 60 degrees, using four trocars Pneumoperitoneum was initiated with the veress needle technique and maintained at 13–14 mmHg by insufflation of carbon dioxide. In the laparoscopic approach, we used a combination of monopolar cautery and ligasure for dissection.

For the right laparoscopic adrenalectomy, a monitor was placed at the right shoulder of the patient while the surgeon and assistant stood on the left side of the patient. The sites of the troacars were the first one at the anterior axillary line, 2 fingers wide below the costal margin; this was the site of the camera, for which we used a 10mm 30-degree scope; and the second one at the mid-axillary line, just below the costal margin. 5mm trocar for the left-hand instrument of the surgeon, the third one at the midclavicular line just below the costal margin 5mm trocar for the instrument of the right hand of the surgeon, the fourth one at the epigastric area 5mm trocar for liver retractor We start dissection by elevating the liver by laparoscopic retractor, then releasing the liver from the upper pole of the gland by using monopolar cautery. Then we start dissection at the

medial side of the inferior vena cava until we identify the adrenal vein, which is usually sited at the upper medial part of the gland posterolateral to the inferior vena cava. We use laparoscopic clips for ligation of the vein, two clips medially and one laterally, and we cut in between by scissors. Then dissection by ligasure started up to the right renal vein inferiorly, followed by ligation of the superior, middle, and inferior adrenal arteries by ligasure. Medial to lateral dissection until the gland is removed from its bed, the specimen is extracted through a retrieval bag through a mini laparotomy incision, and one tube drain is inserted at the sub-hepatic area.

In a left laparoscopic adrenalectomy, the monitor was placed on the left side of the patient, while the surgeon and assistant were on the right side of the patient. The sites of the trocars were the first one at the anterior axillary line, hand breadth below the costal margin for the camera (10 mm, 30-degree scope), and the second one at the midclavicular line. 2 fingers below the costal margin for the left-hand instrument of the surgeon (5mm trocar), and a third one at the mid-axillary line just below the costal margin (5mm trocar) for the instrument of the right hand of the surgeon. We start dissection by mobilizing the splenic flexure. The lateral attachments of the spleen are taken down, and care must be taken to avoid capsular tears. Splenic mobilization continued until the greater curvature of the stomach and left crus of the diaphragm became visible. Take care not to injure the pancreatic tail. Dissection continued up to the left renal vein inferiorly. Identification of the adrenal vein joining the inferior phrenic vein Adrenal vein ligated with two clips medially and one laterally and cut in between with scissors; dissection of the gland with ligasure sealed the small superior, middle, and inferior adrenal arteries. Dissection of the gland circumferentially until it is removed from its bed and extracted through a retrieval bag through a mini laparotomy incision Tube drain inserted at the peri-spleenic area.

Postoperative management: All patients received intravenous fluids informed of crystalloids, analgesia, and vital sign monitoring. A patient with cushing syndrome received intravenous hydrocortisone, which started after the removal of the cushing adenoma. Early mobilization on the same day of surgery and feeding started on the first postoperative day for laparoscopic surgery, while mobilization was delayed until the first postoperative day in open surgery due to postoperative pain.

RESULTS:

There were 33 adrenal tumors; 21 were female (63.7%), and 8 were male (36.3%). The age of patients classified as equal and less than 40 years and other groups more than 40 years was 18, 18 were >40 years (54,5%), and 15 were 40 years (45,5%). Patients were classified geographically as 13 (38.1%) lived in Misurata city and 20 (61.9%) lived outside the city. The most common symptoms were headaches seen in 14 patients (42.4%), all of whom were hypertensive. Functional tumors were seen in 25 cases (75.8%), and nonfunctional tumors in 8 cases (24.2%). Malignant tumors were seen in 6 cases (18.2%), benign tumors in 27 cases (81.8%), as shown in Table 1.

Pheochromocytoma seen in 11 cases (33,3%), Conns adenoma seen in 5 cases (15,1%), Cushing syndrome in 5 cases (15,1%), malignant pheochromocytoma in 4 cases (12,1%), incidentoloma in 6 cases (18,1%), and adrenocortical carcinoma in 2 cases (6%). Serum potassium levels were low in 5 cases (15,1%) and normal in 28 cases (84,9%). Hypertension was seen in 24 patients (72,7%), while in 9 patients, blood pressure was normal (27,3%). The right adrenal tumor was found in 21 cases (63.6%), and the left adrenal tumor in 12 cases (36.4%). The size of the tumor was 18 cases equal to or less than 4 cm (54,5%), and 15 cases greater than 4cm (45,5%). MRIs were done in only 5 cases (23.8%).

Table 1: Demographic and clinical data related to our study.

Demographics	Number	%
Female	21	**63,7%**
Male	12	**36,3%**
>40 years	81	**54,5%**
<40 years	15	**45,5%**
Right	21	**63,6%**
Left	12	**36,4%**
<4cm	18	**54,5%**
>4cm	15	**45,5%**
Hypertensive	24	**72,7%**
Non hypertensive	9	**27,3%**

Laparoscopic adrenalectomy was done in 23 cases (69.7%), open adrenalectomy in 10 cases (30.3%), and four cases converted to open (12.1%). Operative time was divided into two groups: less than 2 hours group had 20 cases (60.6%), 18 of them were laparoscopic (90%) and two of them were open (10%); more than 2 hours group had 13 cases (39.4%), five of them were laparoscopic (38.5%), and eight of them were open (61.5%), P = 0.05. Preoperative preparation for 19 cases (57.6%) and 14 cases with no need for preparation (42.4%). Early ambulation on the same day of surgery occurred in 20 cases, all of them laparoscopic, P = 0.0005. CT scan and histopathological measurement were the same in 6 cases (18,2%), while the sizes were greater by one or half a centimeter in histopathological measurement in 29 cases (87,9%). Patients discharged on postoperative day 3 or less were 20 cases (60,6%); all were laparoscopic cases (100%). Patients discharged on postoperative day >3 had 13 cases (39,4%); three of them were laparoscopic (23,1%), while ten of them were open (76,9%), P = 0.0002. Thirty-day mortality was 3%.

DISCUSSION:

The transperitoneal approach, first successfully performed by Gagner in 1991, is the most common surgery for adrenal tumors. The suspected primary malignant adrenal tumors should be considered for open resection, but the best surgical approach is still a matter of debate. The suspicious signs of malignancy were identified by preoperative

imaging on a CT scan with: local invasion of adjacent structures; distant metastases; size >6cm; irregular borders; hemorrhage within the mass; a low level of intracellular lipid; and high vascularity.

Of 33 adrenal tumors, 21 were female (63,7%) and 12 were males (36,3%), so the female to male ratio was 2:1; the incidence in other literature was the same (1). The average age of patients classified as equal and less than 40 years and other groups more than 40 years was 46 years; 18 were >40 years (54.5%), and 15 were 40 years (45.5%). The average age by the American Cancer Society was 46 years. The most common symptoms were headache seen in 14 patients (42,4%), abdominal pain in 6 cases (18,9%), abdominal mass in 4 cases (12,1%), insomnia in one case (3%), and fatigability and weakness in 3 cases (9,1%), which were the most commonly discovered adrenal tumors with other symptoms (9). In our research, functional tumors were seen in 25 cases (75.8%), nonfunctional tumors in 8 cases (24.2%), but in American cancer society and literature, nonfunctional tumors were most common, forming 60% of adrenal tumors. Malignant tumors were seen in 6 cases (18.2%), benign tumors in 27 cases (81.8%), the same as in the American Cancer Society and literature, where benign tumors formed >90% of cases (6). Pheochromocytoma was seen in 11 cases (33.3%); in the literature, pheochromocytomas were 10% (4). Conn's adenoma was seen in 5 cases (15,1%); in literature, aldosteronoma were 1% (6). Cushing syndrome in 5 cases (15.1%), In America, the cortisol-producing adenoma rate was 5% (1). Malignant pheochromocytoma in 4 cases (12,1%); in the literature [20], the malignant pheochromocytomas were 4%. Incidenteloma occurred in 6 cases (18,1%), and in the nonfunctioning adenoma, 60% (5). Adrenocortical carcinoma was found in 2 cases (6%); in the literature, the adrenocortical carcinoma rate was 5% (6). Serum potassium levels were low in 5 cases (15,1%) and normal in 28 cases (88,4%). Hypertension was seen in 24 patients (72,7%); nine of them had pheochromocytoma, but two cases of pheochromocytoma had normal blood pressure; four of the hypertensive patients had cushing syndrome, but one case of cortisol-producing adenoma had normal blood pressure; five of the hypertensive patients were diagnosed with aldosteronoma; and six of the hypertensive patients had nonfunctional adenoma. Right adrenal tumors were in 21 cases (63,6) and left adrenal tumors in 12 cases (36,4%), so right adrenal tumors were more common in our research and in the literature (7). The size of the tumor was 18 cases equal to or less than 4 cm (54,5%); all of these cases were benign; 15 cases were more than 4cm (45,5%); malignant tumors were seen in 6 cases, all of them >9cm. MRIs were done for 5 cases only (15.1%); in other cases, MRIs were not done due to unavailability. Laparoscopic adrenalectomy was done in 23 cases (69.7%), and open adrenalectomy in 10 cases (30.3%). Operative time was divided into two groups: less than 2 hours group had 20 cases (60.6%), 18 of them were laparoscopic (90%) and two of them were open (10%); more than 2 hours group had 13 cases (39.4%), five of them were laparoscopic (38.5%), and eight of them were open (61.5%), so we found that the laparoscopic approach was associated with less operative time. Preoperative preparation for 19 cases (57,6%) was done for a case of pheochromocytoma by starting alpha blocking for about 7–10 days until the blood pressure reached the range and the patient developed postural hypotension. After that, we started beta blockers to overcome tachycardia. Other cases that needed preparation were Aldosteronoma were prepared by potassium sparing diuretics and potassium replacement until the potassium level reached a normal serum level. Fourteen cases with no need for preparation (42.4%). Postoperative blood sugar levels were seen as low in 2 cases (6%), normal in 25 cases (75.8%), and high in 6 cases (18.2%). Patients discharged on postoperative day 3 or less were 20 cases (60,6%); all were laparoscopic cases (100%). Patients discharged on postoperative day >3 had 13 cases (39,4%); three of them were laparoscopic (23,1%), while ten of them were open (79,9%), so in our research we found that laparoscopic adrenalectomy was associated with a shorter hospital stay than in the literature (4). In comparison, the size of adrenal tumors between CT scan and histopathological measurement was the same in 6 cases (18,2%), while the sizes were larger by one or half a centimeter in histopathological measurement in 29 cases (87,9%). Our complications rate was 18,9%, while in the literature it was 13-27%. Thirty-day mortality was (3%) in our research, while it was 2.2% in the literature (2).

CONCLUSION:

Surgical treatment of adrenal tumors consists of laparoscopic and open adrenalectomy. The type of surgery depends on the size of the tumor and the suspicion of malignancy in the imaging study. Laparoscopic adrenalectomy is safe and effective for benign tumors with decreased operative time, less postoperative pain, and a decreased hospital stay.

REFFERENCE:

1. Courtney M.Townsend RDB, B.Mark Evers, Kennethl. Mattox, Sabiston textbook of surgery 19th edition, 2012: 963-993.
2. Lal G, Duh QY. Laparoscopic adrenalectomy--indications and technique. Surg Oncol. 2003;12(2):105-23.
3. Barreca M, Presenti L, Renzi C, Cavallaro G, Borrelli A, Stipa F, et al. Expectations and outcomes when moving from open to laparoscopic adrenalectomy: multivariate analysis. World J Surg. 2003;27(2):223-8.
4. Smith CD, Weber CJ, Amerson JR. Laparoscopic adrenalectomy: new gold standard. World J Surg. 1999;23(4):389-96.
5. Terzolo M, Bovio S, Pia A, Reimondo G, Angeli A. Management of adrenal incidentaloma. Best Pract Res Clin Endocrinol Metab. 2009;23(2):233-43.
6. Hallfeldt KK, Mussack T, Trupka A, Hohenbleicher F, Schmidbauer S. Laparoscopic lateral adrenalectomy versus open posterior adrenalectomy for the treatment of benign adrenal tumors. Surg Endosc. 2003;17(2):264-7.
7. Walz MK, Alesina PF, Wenger FA, Koch JA, Neumann HP, Petersenn S, et al. Laparoscopic and retroperitoneoscopic treatment of pheochromocytomas

and retroperitoneal paragangliomas: results of 161 tumors in 126 patients. World J Surg. 2006;30(5):899-908.
8. Gagner M, Lacroix A, Bolté E. Laparoscopic adrenalectomy in Cushing's syndrome and pheochromocytoma. N Engl J Med. 1992;327(14):1033.
9. Bracci B, De Santis D, Del Gaudio A, Faugno MC, Romano A, Tarallo M, et al. Adrenal Lesions: A Review of Imaging. Diagnostics (Basel). 2022;12(9).
10. Saeger W. Neues aus der Tumorpathologie der Nebenniere. Der Pathologe. 2015;36(3):301-9.