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Surgical Management of Adrenal Tumors: Experience of Three Tertiary Hospitals in Yaounde, Cameroon

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Abstract

Introduction: Surgical management of adrenal tumors has greatly improved over the past years, with laparoscopic adrenalectomy being the gold standard. However, Open adrenalectomy is indicated in large adrenal tumors, malignant tumors and large phaeochromocytomas. We report surgical outcomes of 18 cases of functional adrenal tumors from 2007 to 2022. **Methods:** We conducted a retrospective cross-sectional and descriptive study in three tertiary hospitals in Yaounde, Cameroon. We reviewed files of patients who underwent adrenalectomy over a period of 15 years from July 2007 to July 2022. Clinical and diagnostic components of adrenal tumors, indications and surgical outcomes were analyzed. **Results:** A total of 18 patients were included in our study. The average age of patients was 38.33 years, with a female-to-male sex ratio of 2:1. Weight gain (72.2%) was the most represented clinical sign. The secretory nature of tumor and malignancy represented 55.5% and 33.3% of the operative indications and all 18 (100%) of the patients had open adrenalectomy. Vascular injury was the most common intraoperative complication with 5.63%, while acute adrenal insufficiency (16.7%) was the most common post-operative complication. The average tumor size was 6.22 cm and the mean duration of hospitalization was 11.61 days. Adenoma 7 (38.9%) and adrenocortical carcinoma 5 (27.8%) were the frequent histological types. One patient died two months post-surgery from anemia-related complications. **Conclusion:** The success of adrenal surgery is linked to multidisciplinary patient care

and the experience of the surgeon. Conventional surgery still has indications with satisfactory short- and medium-term results in our context.

Keywords

Adrenal Tumors, Surgical Management, Outcome, Yaounde

1. Introduction

Surgical management of adrenal tumors has greatly improved over the past years. The means of diagnosis are more precise, and management is multidisciplinary, including urologists, endocrinologists, anesthetists, biologists, oncologists, radiologists and pathologist [1].

Adrenal masses are most frequently benign and could be a sign of secondary localization of a primitive tumor or a secondary adrenal tumor. Most often are diagnosed incidentally due to the progress of medical imaging. The prevalence of adrenal tumor is estimated at approximately 5% on abdominal CT scan examinations and autopsy series [2]. These tumors could also be discovered in patients with hormonal hyper secretions. A study conducted in Cameroon by Nouedoui and colleagues in 1990-1997, at the Yaounde General Hospital reported the diagnosis of 7 adrenal incidentaloma following abdominal imaging among which two were benign. Three had tumoral calcifications and four of the tumors were non-secreting [3]. Adrenal tumor diagnosis raises three preoccupations: its benign or malignant nature, its secretory functions and indications for surgical management. Adenomas constitute the most common secretory adrenal tumors with the least common being pheochromocytomas. Morbidity and mortality of these tumors are usually due to cardiovascular risk factors including hypertension and infra-clinical or patent Cushing syndrome. Management of adrenal tumors is multi-disciplinary and most often surgical treatment is indicated when the tumor has functional and malignant characteristics [4].

Open adrenalectomy was the only surgical option for the management of functional adrenal tumors before the introduction of laparoscopic adrenalectomy in the early 1990s. Adrenal gland surgery emerged as part of abdominal surgery in the 19th century, with Knowsley-Thorton reporting the removal of a large adrenal tumor in 1889 [4].

The anterior approach was first described by Cahill, a pioneer adrenal surgeon. The posterior approach was originally described by Young and offered surgical advantages of being sub-diaphragmatic, extra-peritoneal, extra-pleural and clinical advantages of being associated with less post-surgical mobility [5].

Minimal invasive adrenalectomy has become the gold standard for the treatment of most patients presenting with adrenal tumors; notwithstanding, open adrenalectomy still has its indications and is a surgical procedure which is complex and mostly carried out in centralized referral centers. Its main indications include Patients with large tumors (>6 - 8 cm), large pheochromocytomas, and

cortical adrenal tumors suspected of malignancy either because of radiological characteristics or signs of local invasion and tumor [6]. The success of surgical treatment is evaluated biologically by the decrease in plasma cortisol level post-surgery, a hormone which is vital for the normal functioning of the body. This is also a biological marker to evaluate residual adrenal functions [7].

Mbouche *et al.* in a case series of seven functional adrenal tumors reported in Yaounde, three patients with perioperative morbidity including a patient with adrenal insufficiency and two cases of mortality which were due to hypovolemic shock per-operatively and anaphylactic complications during transfusion post-surgery. These patients did not have multidisciplinary consultations and were all operated using the trans-peritoneal approach [8].

Takongmo and colleagues during a 14 years retrospective study reported the diagnosis and management of 9 cases of histologically confirmed pheochromocytoma in Yaounde. However, the management and outcome of other adrenal tumors were not evaluated in this study [9].

It is on this background that we report our experience on the surgical management of adrenal tumors at three tertiary hospitals in Yaounde Cameroon over a period of 15 years.

2. Methods

2.1. Study Design and Participants

We retrospectively reviewed records of 18 patients who had adrenalectomy over the period of 15 years (July 2007 to July 2022) at the urological surgical unit of three referral hospitals in Yaounde; Yaounde Central Hospital (YCH), Yaounde General Hospital (YGH), and Yaounde Gynecology,Obstetrics and Pediatric Hospital (YGOPH). We included all patients who underwent adrenalectomy indicated for functional adrenal tumors. Ethical clearance was approved by the institutional ethics committee. Data on demographics, clinical symptoms, ultrasound and CT scan findings, operative findings and post-surgical outcomes was recorded for each patient. Data collection was achieved using self-designed structured questionnaires. Validity and reliability of the questionnaire were done. The questionnaire is made up of 9 sections (sociodemography, past medical history, clinical features, biological investigations, radiological investigations, surgical management, post-surgery, diagnosis, adjuvant therapy, and surveillance) (see **Appendix**). Data was collected by consulting patient records, post-surgical reports and by carefully viewing videos of the different operative procedures.

The adrenal tumor was diagnosed by doing a clinical examination of patients, hormonal assays, Doppler abdominal ultrasound and abdominal CT scan was done for all patients. Secretory adrenal tumors were defined as patients with adrenal mass presenting with raised hormonal assays and or raised serum or urinary catecholamines.

2.2. Surgical Technique

Open adrenalectomy was done under general anesthesia and endotracheal intu-

bation was in the supine position.

Anterior sub-coastal incision is made 2 cm below the coastal margins extending from mid clavicular line to the mid axillary line (Figure 1). Incision at the line of Toldt with medial mobilization of the descending colon was realized. The spleno-colic ligament is divided, and the splenic flexure is mobilized medially (Figure 2). The retroperitoneum is opened along the inferior border of the pancreas by dividing the leno-renal ligament. Exposure of the left adrenal vein is obtained by retracting the spleen and pancreas superiorly. The left adrenal vein is identified as it courses from the inferio-medial border of the left adrenal gland into the left renal vein and is ligated and divided (Figure 3). The medial attachments to the aorta can now be taken either with monopolar diathermy on a long right-angle instrument or with a harmonic scalpel while applying gentle lateral traction on the gland. The lateral and inferior attachments to the kidney are taken by blunt and sharp dissection off the renal capsule, taking care to avoid the vasculature to the renal upper pole (Figure 4). Excision en monobloc of adrenal tumour is done (Figure 5). Excision of a large adrenal tumor measuring 14 cm on its longest axis was done (Figure 6).

2.3. Statistical Analysis

Data was analyzed using EPI info 7.0. Parametric variables were reported as means and standard deviations and percentages and counts were used to report categorical variables.

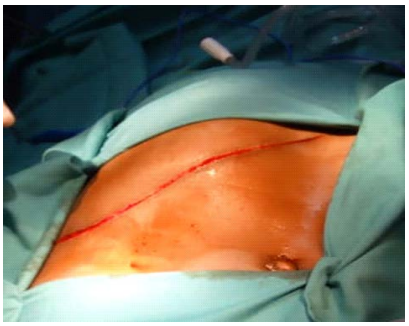

Figure 1. Right anterior sub-costal extraperitoneal approach during right adrenalectomy for a massive right adrenal tumor. (*Source*: *Urology service YCH*)

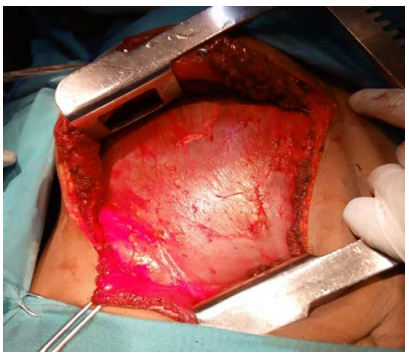

Figure 2. Left subcostal extraperitoneal approach. (*Source*: *Urology service YCH*)

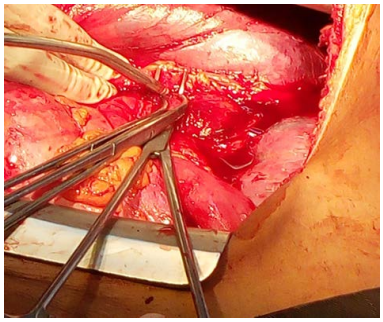

Figure 3. Vascular control with identification and ligature of the adrenal vessels. (*Source*: *Urology service YCH*)

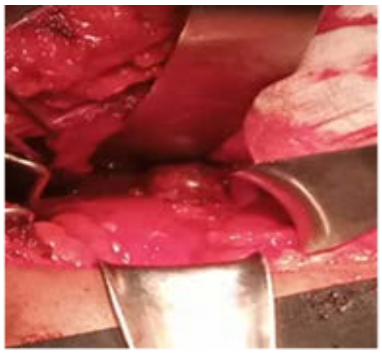

Figure 4. Exposition of right adrenal tumor after kochers maneuver. (*Source*: *Urology service YCH*)

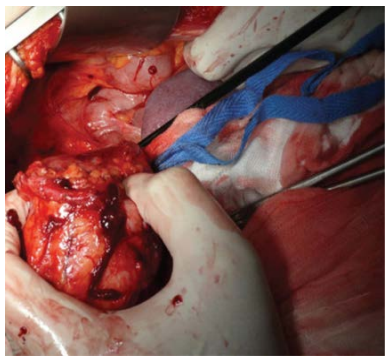

Figure 5. Excision en bloc of right adrenal tumor. (*Source*: *Urology service YCH*)

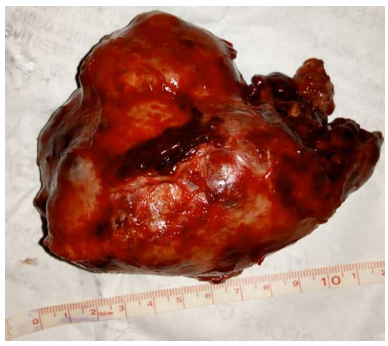

Figure 6. Large adrenal tumor following surgical excision measuring 14 cm on its longest. (*Source*: *Urology service YCH*)

3. Results

A total of 18 files of patients who had adrenalectomy were collected.

3.1. Socio-Demographic Characteristics

We registered 18 patients operated on for adrenal tumors in 15 years. This corresponds to an incidence of 1.2 cases per year. This included 11 patients from the YCH, 5 patients from the YGH and 2 patients from the YGOPH.

The mean age of patients was 38.33 ± 9.40 years old (range: 17 - 69 years) the predominant age group was 30 to 40 years and we recorded one pediatric case of 17 years. Females were most affected with a female-to-male ratio of 2:1 (Table 1).

3.2. Clinical Features

Weight gain (72.2%) and asthenia (44.4%) were the most reported symptoms at consultation. Throbbing headache (38.9%), palpitation (38.9%), and secondary amenorrhea (33.3%) were also symptoms frequently reported among participants. The triad of hypertension, palpitation and headache was common in most of the patients presenting with pheochromocytoma (Table 2). The physical examination was normal in 10 patients (55.6%). However, we had facial and central obesity among (44.4%) of patients and a palpable mass at the level of the abdomen in 22.2% of patients. Four patients (22.2%) had multiple stretch marks and cutaneous eruptions and 3 patients (16.7%) presented with bruising and a buffalo hump (Table 3).

3.3. Operative Indications

Malignant tumors and secretory adrenal gland tumors presenting clinically as Cushing's syndrome and pheochromocytoma were the main indications for surgical management. Furthermore, the large size of these tumors was also a surgical indication.

Majority of patients (88.9%) had a multidisciplinary consultation before surgery. This was done by a team consisting of urologists, endocrinologists, anesthesiologist,

Table 1. Socio-demographic data.

Socio-demographic parameters	Count (N = 18)	Percentage (%)
Age group (years)		
≤20	2	11.1
[20 - 30[	3	16.7
[30 - 40[	6	33.3
[40 - 50[	3	16.7
≥50	4	22.2
Gender		
Male	6	33.3
Female	12	66.7

Table 2. Functional signs and symptoms.

Functional signs and symptoms	Count (N = 18)	Percentage (%)
Presenting complaint		
abdominal distension/pains	4	22.2
Amenorrhea	4	22.2
weight gain	13	72.2
weight loss	3	16.8
Asthenia	8	44.4
Palpitation	7	38.9
Headache	7	38.9
profuse sweating	5	27.8
Secondary amenorrhea	6	33.3
Decrease libido	6	33.3
Ascending constrictive pain	6	33.3

Table 3. Physical signs of adrenal tumours.

physical signs	Count (N = 18)	Percentage (%)
Performance status index (WHO)		
GRADE I	12	66.7
GRDE II	6	33.3
Facial and trunkal obesity	8	44.4
Easy bruising	3	16.7
Cutaneous eruptions	4	22.2
Signes of virilism	2	11.1
Amyotrophie of lower limbs	1	5.6
Cardiac arrhythmias	1	5.6
Palpable tumor in the abdomen	4	22.2
Gallactorrhoea	1	5.6
Stretch marks	4	22.2
Bufallo hump	3	16.7
Palpable flank mass	2	11.1
Clitoral hypertrophy	1	5.6
Hirsutism	1	5.6

pathologist and radiologists. All patients had anesthetic evaluation and 61.1% of patients were staged ASA I. All patients were operated using general anesthesia and oro-tracheal intubation

3.4. Operative Results

1) Techniques used

All patients had open total adrenalectomy using the anterior sub-coastal ap-

proach in 16 (88.9%) of patients and the anterior midline approach in 2 (11.2%) of patients in our study. The surgeon's approach was extra peritoneal among 10 (56.6%) patients and trans-peritoneal with 8 (44.4%) patients. The different intraoperative findings encountered include localized tumors in 13 patients, two large adrenal tumors without peri-renal infiltration, a large renal tumor with ipsilateral adrenal extension, one large right adrenal tumor with extension to the right kidney and inferior vena cava (Table 4).

2) Per operative complications

We recorded 5 patients with per-operative complications in the current study. This included bleeding, breech of peritoneum, hypertension and persistent hypovolemic instability in one patient who later died following persistent hypovolemic shock despite resuscitation and reanimation. The deceased patient was operated using the trans-peritoneal approach (Table 5).

Table 4. Type of surgical intervention.

Type of surgical intervention	Count (N = 18)	Percentage (%)
Type of surgical intervention		
Laparoscopic	0	0
open surgery	18	100.0
Patient installation		
Decubitus dorsal	18	100
Decubitus ventral	0	0
Decubitus lateral	0	0
Surgical technic		
Total adrenalectomy	18	100.0
Partial adrenalectomy	0	0
Surgical approach		
anterior midline	2	11.2
Anterior Subcostal	16	88.9
Surgical attitude		
Trans-peritoneal	8	44.4
Extra-peritoneal	10	55.6
Findings		
Large adrenal tumour without perirenal infiltration	2	11.1
Renal tumour with adrenal involvement	1	5.6
Large tumour with extension to the kidney and ivc	1	5.6
Large adrenal tumour with infiltration of para-renal	1	5.6
Localised	13	72.2

Table 5. Per-operative surgical complications.

Surgical complications	Count (N = 18)	Percentage (%)
Per-operative complications		
Yes	**5**	**27.8**
No	**13**	**72.2**
Hypertension	1	5.6
Hypotension	2	11.1
Bleeding	2	11.1
Cardiac arrest	1	5.6
Peritoneal breech	1	5.6
Pleural breech/injury	0	0
IVC injury	1	5.6
Adjacent organ injury	0	0

3) Blood loss and transfusion:

The average blood loss was estimated at 300 cc with extremes ranging from 200 cc to 2500 cc. 4 patients were transfused preoperatively. 1 patient received 4 units of blood preoperatively due to excessive bleeding following a major vascular injury.

4) Duration of intervention:

The mean duration of surgical intervention was 165.3 ± 43.1 mins with extremes ranging from 150 mins to 265 mins

5) Size of tumor excised:

The average size of the tumor excised was 7.11 ± 5.1 cm with tumor sizes ranging from 3 cm to 25 cm. One patient had a right radical nephrectomy due to a right large adrenal tumor with ipsilateral renal extension (Table 6).

3.5. Outcomes

Post-operative care was multidisciplinary including endocrinologists management which began immediately post-surgery. Most of these patients were placed on hydrocortisone supplement to prevent adrenal insufficiency which is usually common among these patients post-surgery.

Post-operative evolution was favorable in 13 (72.2%) patients. However, we recorded 5 (27.8%) patients with post-surgical complications among which 3 (16.7%) had acute adrenal insufficiency, 1 (5.6%) had superficial surgical site infection and 1 patient had retroperitoneal abscess. We recorded 1 case of post-operative mortality 5 weeks following surgery from anemia-related complications (Table 7).

The mean duration of hospitalization following surgery was 8.6 ± 3.8 days with extremes ranging from 6 to 21 days. The hospitalization for 21 days was observed in a patient who presented with right retroperitoneal abscess post-surgery. Ultrasound guided percutaneous drainage of the retroperitoneal abscess was done

Table 6. Duration of surgery, specimen size and duration of hospitalization.

Parameters	Mean SD	Median (IIQ)	Min—max	Mode
Duration of surgery	165.3 ± 43.1	182 (150 - 190)	150 - 265	150
Specimen size	7.11 ± 5.1	5.5 (4 - 7.5)	3 - 25	4
Drain duration	5.01 ± 1.2	4 (3 - 5.5)	3 - 10	5
Hospital stay duration	8.6 ± 3.8	7(7 - 9.5)	6 - 21	7

Table 7. Post-surgical complications.

Post-surgical complications	Count (N = 18)	Percentage (%)
Post-surgical complications	**5**	**27.8**
Anemia	2	11.1
Surgical site infection	1	5.6
Acute adrenal insufficiency	3	16.7
Conn disease	0	0
Hypovolemic shock	0	0
Retroperitoneal abscess	1	5.6
Death	1	5.6

with favorable outcome. The delay period for patients to return to their normal activity was 30 ± 4.34 days (range: 3 - 45 days).

13 (72.2%) of patients received steroid supplement therapy using hydrocortisone. This was begun on day 1 post-surgery. 2 patients received adjuvant chemotherapy using mithotane. These patients were those with histopathologic confirmation of adrenocortical carcinoma (ACC) (Table 8).

All patients had histopathological analysis of specimens (100%). Adrenal adenoma 7 (38.9%) and adrenocortical carcinoma 4 (22.2%) were the most frequent histologic type (Table 9).

4. Discussion

This study on characteristics, indications and surgical outcomes of patients with adrenal tumors has shown that all tumors present intra-abdominally, are located in the adrenal gland and were mostly benign tumors. Complete recovery was documented in the majority of the patients, and, despite the high rate of perioperative complications, the overall mortality was low. Clinical presentation in most patients included weight gain, asthenia and the classical triad (headache, palpitation and excessive sweating) associated with hypertension was present in most patients who presented with pheochromocytoma.

Laparoscopic technique was the first treatment modality of most adrenal tumors [6]. However, open surgery is still indicated in large and malignant adrenal tumors. In our context (developing countries and low technical platforms), minimally invasive surgery is not always available and accessible [8] [9].

Table 8. Clinical surveillance post-surgery.

Adjuvant treatment	Count (N = 18)	Percentage (%)
Hydrocortisone supplementation	13	72.2
Chemotherapy	2	11.1
Clinical surveillance		
Resolution of initial clinical signs	14	77.8
Appearance of new signs	5	27.8
Relapse	2	11.1
Control abdominal CT scan	8	44.4

Table 9. Histopathological results.

Histopathological result	Count (N = 18)	Percentage (%)
Cushing's adenoma	7	38.9
Adrenocortical carcinoma	4	22.2
Myelolipoma	2	11.1
Phaeochromocytoma	3	16.7
Conn's adenoma	1	5.6
Renal tumour with extension to the adrenal gland	1	5.6

We recorded 18 patients who had adrenalectomy for adrenal tumors over 15 years during this study, giving an incidence of 1.2 cases per year. This finding is higher than that reported by Takongmo *et al.* (0.06) and lower than that of Zorgani *et al.* who had an incidence of (2 - 4) [9] [10]. Studies in developed countries have shown an increased prevalence and incidence of adrenal tumors [8] [11] [12] [13]. This could be attributed to the availability of social security, diagnostic and therapeutic means such as minimally invasive surgery which is not easily accessible in our context. The mean of patients was 38.33 years with a female predominance of 66.3%. These findings are similar to that reported in the literature [8] [10] [13]. The reasons for these gender disparities are not well established.

Clinical presentation in most patients included weight gain (72.6%) and asthenia (44.4%) with an average BMI of 31 among participants.

The classic pheochromocytoma triad (headache, 38.9%; palpitations, 38.9%; and sweating, 27.8%) associated with hypertension were presenting symptoms in the majority of patients, especially those who presented with pheochromocytoma, confirming the classical hyper-adrenergic spells of adrenal tumors. This is lower compared to the available literature, which reports headaches in 55% - 90%, palpitations in 50% - 77% and sweating in 40% - 74% of patients with pheochromocytoma [14] [15] [16]. This could be explained by the fact that our study did not only include patients with pheochromocytoma, but rather included all patients presenting with different types of adrenal tumors.

Arterial hypertension was the most frequently presenting clinical finding, found in 55.6% of the current study, which is quite close to the figures (90% - 100%) from most available reports [14] [15], except one study that reported a low rate (45%) [16]. About 9 patients (50.0%) had grade I hypertension while one (5.6%) patient had grade II hypertension and no patient presented with grade III arterial hypertension. Furthermore, in our study, sustained hypertension (44.4%) was more common than paroxysmal hypertension (11.2%), which is similar to studies from Asia and Europe [14] [15] [16], but higher than other studies, which report similar proportions for both types [17] [18]. Hypertension persisted in 22.2% after successful resection of the tumor (as defined biochemically and radiologically); similar findings have been reported from centers in Asia [14] [15] and Sweden [19], with rates of 10% - 35%. This may be related to the late presentation with target organ (renal) involvement from hypertension or the coexistence of essential hypertension in this study.

Incidental adrenal tumors (Incidentalomas) can be discovered by chance on an imaging assessment. The notion of fortuitous discovery of adrenal mass is common and has been reported in different series (1% to 8.7%) [20] [21]. In our series, one incidental adrenal tumor was discovered by chance (5.6%). This result is similar to that reported in the literature [22] [23].

A palpable adrenal mass is highly suspicious of adrenal malignancy or secondary malignant extension. This is because most adrenal tumors are not palpable. In our series, 4 (22.2%) patients had a palpable abdominal mass.

Cushing's adenoma accounted for the majority in this study (38.9%). Available reports are variable with some studies reporting high rates [24].

Consistent with the available literature [19] [25], benign tumors (72.2%) were far more common than malignant in our setting; however, the frequency of malignant adrenal tumors (27.8%) is higher than the 4% - 15% reported [16] [25]; and probably accounts for the high proportion of large tumors found in this study.

Contrary to other studies [11] [26] [27], familial syndromes were not diagnosed in our study. In our setting, no patient reported a family history of MEN2A. This could be explained by the fact that unlike other studies where genetic tests were used to diagnose inherited cases [15] [19], in this study familial tumors were screened primarily on the basis of the positive family history of adrenal tumor and the presence of biochemical and radiological features of other components of inherited tumors such as bilateral adrenal tumors, renal cell carcinoma, or medullary thyroid carcinoma. Selective genetic testing is not still available at our centers.

In the current study, 57.1% of patients were diagnosed based on biochemical results following positive hormone secretion in 10 (55.6%) of patients. This is much lower than that reported (88.8% - 96.5%) in other studies [11] [28], and is probably accounted for by the low sensitivity and specificity of the tests used.

Similar to other studies [29] [30], anatomical imaging (CT) was able to correctly localize all tumors preoperatively. This is higher than that reported from a

Chinese study (79%) [18], but similar to other studies (88% - 98%) [21] [25], and may be related to large tumor sizes in this study.

Indications and surgical technique

Treatment of functional adrenal tumors is essentially surgical. The goal is to achieve total excision of adrenal tumors without damage to neighboring organs. Minimally invasive surgery precisely laparoscopic adrenalectomy remains the goal standard of adrenal tumor management [2] [6] [31]. However, open adrenalectomy is indicated in large adrenal tumors (>5 cm), malignant adrenal tumors and large pheochromocytomas [2] [32]. In our study, open surgery was performed on all patients. This could be explained by the unavailability of adequate working platform to perform laparoscopic adrenal (LA) surgeries in our centers. In addition, the surgeons are skilled in performing open adrenal surgery. The secretory nature of the tumor (38.8%), Cushing's syndrome (27.8%) and malignant suspicion (22.2%) were the most common indication for surgical management. These indications are similar to other studies reported in the literature [4] [21] [26]. However, our results are higher than those of Mbouche *et al.* where Cushing's syndrome was reported in 15% - 20% of patients [8]. This difference could be explained by the fact that not all the patients had hormonal assays done.

An anterior subcostal surgical approach was used in the majority of our patients (88.9%), given the fact that large tumors were identified with preoperative localization. This is compatible with the study by Lo *et al.* [18] (mean tumor size 6.4 cm), but higher than in other studies (mean tumor size 4.8 cm) [6] [21] [23]. The mean operative duration in our study was 165.3 days results similar to that of Musina *et al.* [33].

55.6% of patients were operated on using the anterior extra-peritoneal approach while the trans-peritoneal approach was used in 44.4% of patients. This could be explained by the fact that the patients in our study were operated on by two different surgical teams and each of the surgeons used the technique which they mastered best.

The mean tumor size in our study (7.11 cm) was larger than that recorded in other studies (mean 5.2 cm) [27] [34]. This may be accounted for by the late presentation at consultation or delayed referral for specialized care. However, in concordance with other studies [14] [30], malignant tumors (mean size 9 cm) were larger than benign (mean size 4.5 cm).

Outcome:

Complications following open adrenalectomy for adrenal tumors vary in different reported studies (5.6% - 28.6%) [6] [33] [35]. In our study, we had a perioperative complication rate of 22.2%. It was principally vascular injury, the reason for blood transfusion. Post-operative complications observed were acute adrenal insufficiency and surgical site infections. The adrenal insufficiency was due to non-observance to corticosteroid supplementation therapy. The surgical site infection included one parietal suppuration and retroperitoneal abscess which occurred in a patient with diabetes. The average hospitalization days

post-surgery was 8.6 days higher than that reported by Musina *et al.* [33]. This was probably due to the fact that in other studies, the laparoscopic approach was associated with early recovery.

In the present study, chemotherapy (5.6%) was used as adjunctive therapy for patients with metastatic tumors. No patient benefited from adjuvant radiotherapy and this is lower than that for use of chemotherapy (16% - 30%) in other studies [2] [16] [27]. This could be explained by the high cost and scarcity of chemotherapeutic drugs which are sensitive to adrenal tumors in our milieu.

In the current study, 72.2% were deemed as cure (biochemically and/or radiological) and is lower compared to results reported in other studies (79% - 92.6%) [2] [35]. This is probably due to the high rate of adrenocortical carcinoma in our series (**Table 9**).

Available information on mortality rates is variable. The mortality of 11.1% found in this series is lower than that reported by Modigliani *et al.* (13%) [26] whose results may be related to the high proportion of familial cases of adrenal tumors (all patients had either MEN I2A or MEN I2B) in that study. By contrast, low mortality rates have also been reported in the Johannesburg study (5.9 - 7.4%) [10] [23] [35].

Limitations: This study was retrospective with a small sample size. We therefore propose large prospective studies in order to confirm the results of this study.

5. Conclusions

Adrenal tumors despite being rare urological tumors have been encountered during our urological consultations with an increased incidence during recent years. The principal clinical manifestations of these tumors include weight gain, hypertension and asthenia. A high index of suspicion at primary health care levels, surgeons' experience and a multidisciplinary approach are necessary to effectively treat these rare tumors. Laparoscopy remains the gold standard for the management of most adrenal gland tumors. However conventional surgery still has indications with satisfactory short-term and medium-term results in our context.

What is already known on this topic:

- Adrenal tumors are rare urological tumors.
- Laparoscopic adrenalectomy is the gold standard for the treatment of functional adrenal tumors, and it is associated with reduced post-operative complications.

What this study adds:

- Laparoscopic adrenalectomy is a new surgical technique in Cameroon, and it is less practiced.
- Conventional open surgery still has indications with satisfactory short-term and medium-term outcomes in our context.

Conflicts of Interest

The authors declare no competing financial or personal interests.

Authors' Contribution

All the authors contributed to the research work. They read and agreed to the final version of the manuscript.

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Data Collection Form

Questionnaire N0: |_|_| **code**: |_|_|_| Contact Tel Number:……
Date: …. /…. /…. (dd/mm/yy)

SECTION 1: SOCIO-DEMOGRAPHIC DATA		
1	SEX: M = Male, F = Female	|_|
2	Age (in years)	
3	Marital status: S = single, M = married, D = Divorced	|_|
4	Residence	
5	Region of origin: EN = Extreme North, N = North, A = Adamawa, C = Centre, W = west, NW = North west, SW = South west, E = East, L = Littoral	|_|
6	Profession	
SECTION 2: PAST MEDICAL AND FAMILY HISTORY		
7	Chronic pathologies: Y = Yes, N = No	|_|
8	If yes, what type; HTN, diabetes = D, Nephropathy = N, Endocrinopathy = Endoc to precise, Neoplasia = precise, Others (precise)	|_|
9	Use of Medications Y = Yes, N = No	|_|
10	Past surgery Y = Yes, N = No	|_|
11	If yes, precise	|_|
12	Smoking Active = A, passive = P, Non = N	|_|
13	Alcohol comsuption Y = Yes, N = No	|_|
14	If yes, IE = number × volume × % × alcohol density/day	|_|
15	Sedentary life style Y = Yes, N = No	|_|
16	Socio-professional stress Y = Yes, N = No	|_|
17	Similar cas in family, Y = Yes, N = No	|_|
18	Phaeochromocytoma, Y = Yes, N = No	|_|
19	Thyroid medullary carcinoma, Y = Yes, N = No	|_|
20	MEN type I Y = Yes, N = No	|_|
21	Von Hipple—Lindau disease Y = Yes, N = No	|_|
22	Neurofibromatosis Y = Yes, N = No	|_|
23	Other tumor Y = Yes, N = No	|_|
24	If yes precise	|_|
SECTION 3: CLINICAL EXAMINATION		
A-Functional Signs		
25	Presenting complaint or circumstance of diagnosis	
26	Duration of evolution since presentation of first symptom	
27	Weight gain Yes |_|, No |_|	|_|
28	Secondary ammenorrhoea Yes |_|, No |_|	|_|

Continued

29	Decrease libido Yes |_|, No |_|	|_|
30	Bone signs (non mechanical lumbar or pelvic pains) Yes |_|, No |_|	|_|
31	Immunity disorders Yes |_|, No |_|	|_|
32	Psychiatric disorders/problems Yes |_|, No |_|	|_|
33	HTN Yes |_|, No |_|	|_|
34	Neuromuscular signs Yes |_|, No |_|	|_|
35	Constipation Yes |_|, No |_|	|_|
36	PUPD syndrome Yes |_|, No |_|	|_|
37	Cramps and paresthesia of extremeties Yes |_|, No |_|	|_|
38	Dyspnea on effort Yes |_|, No |_|	|_|
39	Intense pulsatile headache Yes |_|, No |_|	|_|
40	Palpitations Yes |_|, No |_|	|_|
41	Profuse sweating Yes |_|, No |_|	|_|
42	Orthostatique hypotension	|_|
43	Ascending constrictive pains:abdomen and thorax Yes |_|, No |_|	|_|
B-Physical Signs		
44	General state: performance status index (WHO)	……
45	Blood pressure	……mm/Hg
46	Pulse	…….Bpm
47	Respiratory rate	……cpm
48	Temperature	……..˚C
49	BMI: weight……(Kg)/Height…….(m)	|_| |_|kg/m^2
50	Waist circumference	…..cm
51	Facial and trunkal obesity Yes |_|, No |_|	|_|
52	Easy bruising Yes |_|, No |_|	|_|
53	Cutaneous eruptions (pupural at pertechies) Yes |_|, No |_|	|_|
54	Signs of virilism Yes |_|, No |_|	|_|
55	Amyotrophie of lower limbs Yes |_|, No |_|	|_|
56	Pseudoparalytic crises Yes |_|, No |_|	|_|
57	Cardiac arrhythmias Yes |_|, No |_|	|_|
58	Gynaecomastia Yes |_|, No |_|	|_|
59	Palpable tumour at the level of the abdomen	|_|
60	Presence of goiter, exolpthalmos and signes of thyroid dysfunction Yes |_|, No |_|	|_|
61	Gallactorrhoea Yes |_|, No |_|	|_|
62	Presence of breast nodule Yes |_|, No |_|	|_|
63	Peculiarities of rest of physical examination …… …… ……	

Continued

SECTION 4: BIOLOGICAL INVESTIGATIONS		
Investigation	**Results**	**Normal value**
Aldosterone		
Plasma renin activity		
24 hrs CLU		
Freinage minute test		
• Midnight cortisol		
• 8 h cortisol		
ACTH		
DHEAS		
Testosterone		
17OHP		
Plasma metanephrines		
24 hrs urinary metanephrines		
Creatinnuria		
Creatinine (mg/l)		
Urea (g/l)		
FBS		
$Na^+/K^+/Cl^-$ (meq/l)		
$Ca^{2+}/PO_4/Mg^{2+}$		
Albuminemia (g/l)		
EPPS		
TSH (IU/l)		
Free T4 pmol/L		
CT/HDL/LDL/TG (g/l)		
FBC, WBC		
Hb		
Platelets		
CRP		
ASAT/ALAT/GGT		
Abdominal ultrasound…….		
……		
……		
Abdominal CT scan:		
• Tumour location: left |_|, right |_|		
• Size of tumour: …….cm		
• Content: homogenous |_|, heterogeneous|_|		
• Spontaneous density: <10 HU |_|, >10 HU |_|		
• Wash out: absolute……..%, Relative…….%		
• Limits: Regular irregular		
• Necrosis: Yes |_|, No |_|		
• Calcifications: Yes |_|, No |_|		
• Infiltration of pararenal fats: Yes |_|, No |_|		
• Hemorrhagic Yes |_|, No |_|		
• Metastasis Yes |_|, No |_|		
Chest X-Ray:…….		
Others: ……..		

Continued

SECTION 6: SURGICAL MANAGEMENT	
A-Pre-surgical preparation	
Pre-anesthetic consultation: ASA……., Altemier	
Pre-surgical investigations:	
FBC, WBC	
Hb	
Platelets, TP	TCK
Urea	creatinine
64	Multidispinary consertations (RCP) Yes |_|, No |_|
65	Medications Yes |_|, No |_|
66	If yes which type of medications?
67	Blood transfusion Yes |_|, No |_|
B-Per operative	
Day of surgical intervention……	
Duration with respect to onset of symptoms	
Type of Anesthesia:……	
Installation of patient:…….	
68	Indications:
69	Type of surgical intervention: Laparoscopic open surgery
70	Surgical technic: 1-Total adrenalectomy, 2-Partial adrenalectomy,
71	Surgical approach: 1-anterior midline, 2-Anterior Subcostal, 3-Anterior bisubcostal 4-thoracoabdominal
72	Surgical attitude: 1 = transperitoneal, 2 = extraperitoneal
73	Intraoperative findings:
74	Per-operative complications: HTN: Yes |_|, No |_| Hypotension Yes |_|, No |_| Bleeding Yes |_|, No |_| Cardiac arrest Yes |_|, No |_| Peritoneal breech Yes |_|, No |_| Pleural effraction Yes |_|, No |_| IVC injury Yes |_|, No |_| Adjacent organ injury Yes |_|, No |_|
75	Duration of surgery:
76	Specimen size……(cm) and weight……..(g)
C-Post surgery	
77	Immediate …… ……
78	Complications: Hemorrhage: Yes |_|, No |_| Anemia: Yes |_|, No |_| Surgical site infection: Yes |_|, No |_|

Continued

	Acute adrenal insufficiency: Yes |_|, No |_| Paralytic ileus: Yes |_|, No |_| Fistulas: Yes |_|, No |_| Death: Yes |_|, No |_| Others
79	hospital stay duration
SECTION 7: DIAGNOSIS (Anatomopathological diagnosis)	
80	Anatomopathological results:…… ……
SECTION 8: ADJUVANT TREATMENT	
Hydrocortisone supplementation Yes |_|, No |_| Chemotherapy Yes |_|, No |_|	
SECTION 9: SURVEILLANCE	
81	CLINICAL: Resolution of initial clinical signs Yes |_|, No |_| Appearance of new signs: Yes |_|, No |_| …… …… Relapse
82	Paraclinical: ● Cortisol 8 h Base 0 - 3 months 3 - 6 months >6 m ● Cortisol 1 H after synacthene test
83	Control abdominal CT scan