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Surgery

LAPAROSCOPIC AND OPEN ADRENALECTOMY SURGERIES FOR MULTIPLE CAUSES: A CASE SERIES IN A TERTIARY CARE TEACHING HOSPITAL, EASTERN ZONE OF INDIA

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ABSTRACT **Background:** The adrenal gland, a crucial endocrine organ, plays a pivotal role in metabolism, stress response, and sexual development. Adrenal tumors can arise due to various genetic, environmental, and idiopathic causes, necessitating surgical intervention through either open or laparoscopic adrenalectomy. This study presents a case series of adrenal surgeries performed in a tertiary care teaching hospital in the eastern zone of India. **Methods:** This retrospective case series examines eleven patients diagnosed with diverse adrenal pathologies, managed surgically between January 2022 and December 2022. Patients presented with a spectrum of clinical manifestations, including hypertension, weight loss, abdominal pain, endocrine abnormalities, and metabolic disturbances. Preoperative evaluation included biochemical profiling, imaging modalities such as Contrast-Enhanced Computed Tomography (CECT), Positron Emission Tomography-Computed Tomography (PET-CT), and relevant hormonal assays. Surgical interventions ranged from laparoscopic adrenalectomy to open adrenalectomy, with histopathological evaluation guiding final diagnosis and postoperative management. **Results:** Among the eleven cases, diagnoses included pheochromocytoma, adrenocortical carcinoma, adrenal tuberculosis, schwannoma, non-functioning adenomas, paraganglioma, incidentaloma, and adrenal cysts. Five patients underwent laparoscopic adrenalectomy, while six required open adrenalectomy due to tumor size, invasiveness, or suspicion of malignancy. A rare case of an adrenal incidentaloma mimicking an accessory spleen and another of adrenal tuberculosis masquerading as adrenal carcinoma were noted. Postoperative outcomes were favorable, with most patients symptom-free at follow-up. **Conclusion:** This case series highlights the diverse presentations, diagnostic challenges, and surgical approaches for adrenal tumors. While laparoscopic adrenalectomy remains the preferred approach for smaller and benign lesions, open adrenalectomy is indispensable for complex, malignant, or large adrenal masses. Further studies are warranted to refine diagnostic modalities and optimize surgical outcomes in adrenal neoplasms.

KEYWORDS : Adrenalectomy, Laparoscopic adrenalectomy, Open adrenalectomy, Adrenal tumors,Pheochromocytoma, Adrenocortical carcinoma, Paraganglioma, Incidentaloma, Adrenal tuberculosis, Endocrine surgery

INTRODUCTION

Laparoscopic and Open adrenalectomy Surgeries for Multiple Causes: A Case Series in a Tertiary Care Teaching Hospital, Eastern Zone of India Introduction The adrenal gland , triangular shaped & two on top of each of the kidney measuring 0.5 inches & 3 inches weighing 4- 5 grams each , with an outer cortex & an inner medulla , is known to be a domicile of hormones which , when released , has been known to be an important determinant of stress , metabolic activity of the body along with sexual development . The cortex of the gland is known to produce hormones of metabolism & the inner medulla would produce hormones of the stress. An important aspect is to elucidate the risk factors should would lead to an adrenal neoplasia would be Beckwith-Wiedemann syndrome, the para- ganglioma syndrome, the li – Fraumeni syndrome, the Von Hippel Lindau syndrome, the von Recklinghausen's disease a.k.a the NF1 or the multiple endocrine neoplasia - 2(MEN 2) syndrome ,the lynch syndrome , the familial adenomatous polyposis (FAP) syndrome , the Carney complex to name a few of the mendelian disorders which are familial , apart from heavy cigarette smoking(> or = 25 cigarettes/day) mostly in men (95% confidence interval 1.0-4.4) [1] , a frank usage of the oral – contraceptive pills in woman especially those who are below 25 years of age (95% CI 1.0-3.2) [1] & consumption of alcohol , though the association with alcohol is still unclear. Mouhammed A et al would document the increased possibility of an adrenal neoplasm with a familial history or a mendelian pattern of inheritance (95% CI -1.9-4.3), therefore the latter may be considered the most important factor [2]

The Case Series

Case 1

A 62-year-old male patient attended the Surgery OPD with hypertension, pain abdomen & loss of weight. After clinical examination & referral to the Endocrine OPD along with specific biochemical tests and imaging, which revealed elevated levels of Serum cortisol(>155nmol/l), serum dehydroepiandrosterone sulfate (DHEAS), hypokalemia, raised Aldosterone: renin ratio (ARR), with a large mass of 8.5x7.2x5.8 cm in the right adrenal gland causing inferior displacement of the right kidney. PET – CT imaging revealed no metastasis. Therefore, against the working diagnosis of adrenocortical cancer, a Right adrenalectomy was performed. **(Figure 1)**

Case 2

A 49 year old female patient presented to the Endocrinology OPD with a long-standing resistant hypertension, recurrent headaches, muscle cramps, occasional numbness of the lower extremities along with extreme fatigue. Blood tests revealed high aldosterone: renin ratio (ARR), Hypokalemia, high values of aldosterone for a 24-hour urine collection, with near to normal cortisol levels after an overnight Dexamethasone suppression test (DST), with a Contrast enhanced Computed tomography of the whole abdomen revealed a mass measuring 3.5X2.8.x3 cm, for which laparoscopic left adrenalectomy was performed. The patient is now off –hypertensives. **(Figure 2)**

Case 3

A 61 year old Female reported to the Gastroenterology OPD & presented with a 3-month complaint of weight loss, extreme fatigue, early satiety & occasional bouts of vomiting. An upper GI endoscopy was performed which revealed no specific cause of Gastric Outlet Obstruction apart from some gastric mucosal atrophy. His routine blood profile also did not show any abnormality. A Helicobacter Pylori eradication kit was advised to the patient empirically by the resident Doctor to which no benefit was observed. After another month, the patient reported to the Gastroenterology OPD where a Contrast Enhanced Computed Tomography of the abdomen was done which revealed a 5.7x3.7x4 cm mass on the left adrenal gland. The routine & the adrenal blood profile so performed was normal after the patient was transferred to the Endocrinology OPD.Thereafter, an exploratory laparotomy was performed by the department of General Surgery, where a left adrenalectomy was done which has turned out to be an accessory spleen surprisingly instead of a Non – functioning adenoma. The patient is now asymptomatic. **(Figure 3)**

Case 4

A 60 year old male patient reported to the Endocrinology OPD was a two-month history of a low-grade fever, weight loss, extreme fatigue, muscle cramps & occasional nausea, vomiting and palpitations. Blood tests revealed hypokalemia, elevated dehydroepiandrosterone sulfate (DHEAS), slightly high values of a 24-hour urine cortisol, slightly elevated Aldosterone: Renin ratio (ARR), near to normal serum

cortisol after an overnight Dexamethasone suppression test (DST), deranged liver enzymes and a high creatinine. After a Contrast enhanced computed tomography of the whole abdomen, a suprarenal mass of 5x4x3.9 cm was deciphered after which the patient was given a dialysis. The patient was then operated by the General Surgery Department where a left open adrenalectomy along a RPLND (retro peritoneal lymph node dissection) was done. Histopathology did surprisingly reveal an Adrenal tuberculosis. Patient was started on Anti Tubercular Drugs based on HPE report, & is now presently symptom free. **(Figure 4)**

Case 5

A 39 year old female presented to the Endocrinology OPD with resistant hypertension, occasional palpitations, fatigue, low grade fever, increased frequency of micturition. Blood tests revealed a near normal 24-hour urinary cortisol, slightly increased Aldosterone:renin ratio (ARR), increased C- reactive protein with White blood cell counts on a slightly higher side.USG revealed an adrenal mass of 1.7cm for which a left sided adrenalectomy was done which was suggestive of an incidentaloma. The patient is now asymptomatic. **(Figure 5)**

Case 6

A 43 year old female patient presented to the Endocrinology OPD with Dyspnea on exertion with palpitation, resistant hypertension, fatigue, occasional muscle cramps with a history of pheochromocytoma in first degree relative and a case of a diagnosed Von –Hippel Lindau syndrome .Blood reports revealed Hypokalemia, high Aldosterone: renin ratio, high 24-hour cortisol levels, deranged liver enzymes, a high creatinine, high dehydroepiandrosterone sulfate (DHEAS) with a deranged Echocardiogram reveling Dilated Cardiomyopathy (DCM) with an ejection fraction of 38 %. The patient did undertake a Contrast enhanced computed tomography followed by a dialysis which revealed a left suprarenal Space Occupying lesion of 42x48x47 mm but a PET – CT revealed bilateral Space Occupying lesions with metabolic activity. Operated by the general surgery department, bilateral subcortical adrenalectomy was done. Patient is now asymptomatic. The Ejection Fraction increased post operatively to 50 %, without requiring steroid support at present. The patient is now under follow up. **(Figure 6)**

Case 7

A 51 year old female patient presented to the Endocrinology OPD with recurrent Hypertension, headache & respiratory distress with a history of left adrenalectomy which has been done 8 years back for left pheochromocytoma. Where blood tests revealed a normal Aldosterone: Renin ratio (ARR), normal cortisol values after an overnight Dexamethasone suppression test (DST) , deranged liver enzymes, high Plasma and urinary metanephrines or catecholamines levels. A 68 –Ga –DOTA-NOC PET CT revealed a Space occupying lesion (SOL) in the left adrenal gland. Therefore, an Open left adrenalectomy was done by the General Surgery Department & the Histopathology examination revealed a paraganglioma. Patient is now asymptomatic following the surgery. **(Figure 7)**

Case 8

A 47 year old female presented in the General Medicine OPD with a high-grade fever for 2 months with occasional spikes, pain in abdomen, fatigue, loss of weight, nausea & vomiting. Blood tests revealed high White blood cell counts with a high C- reactive protein, High pro- calcitonin, deranged liver enzymes with normal serology reports. After being treated conservatively for two weeks, the symptoms did recur and the patient was asked to go for an ultrasound whole abdomen which revealed a Space occupying lesion (SOL) in the right adrenal gland and was thus referred to the Endocrinology department where blood parameters for the adrenal gland was normal with a negative Echinococcal serology. The patient was then operated by the general surgery department which surprisingly revealed an Intraoperative finding of an Endo cyst confirmed by Histopathology (HPE) .Post-operatively Tab Albendazole given for 2 months & the patient thus recovered. **(Figure 8)**

Case 9

A 58 year old female presented to the Endocrinology OPD with resistant hypertension with glucose intolerance. Biochemical tests revealed Borderline raised 24-hour urine metanephrines , Borderline Aldosterone: renin (ARR) ratio, Borderline to slightly high creatinine, hypokalemia & a raised serum cortisol following overnight Dexamethasone suppression test (DST).Contrast enhanced Computed tomography of the whole abdomen followed by dialysis revealed a 33x26x30 mm left adrenal tumor with heterogeneous enhancement for which left open adrenalectomy was performed where the mass was removed revealing a Mixed cortico medullary tumor of adrenal gland. **(Figure 9)**

Case 10

A 60 year old male patient presented with pain abdomen with a lump in the right upper quadrant (RUQ) extending to the right lumbar region with resistant hypertension, fatigue, palpitations, muscle cramps, frequent urination, nausea, vomiting, dyspepsia & occasional dyspnea at the General surgery OPD. Blood tests did reveal a raised dehydroepiandrosterone sulfate (DHEAS) , high values of a 24 hour urine cortisol, elevated Aldosterone:Renin ratio (ARR), elevated values of 24 hour blood cortisol & hypokalemia, high cortisol values of > 150 nmol/L with Triphasic Multi-dimensional computed tomography revealed a huge right adrenal space occupying lesion for which right open adrenalectomy was done revealing a giant pheochromocytoma with dimensions of 17x12x8 cm weighing 820 grams & confirmed by histopathology.(giant pheochromocytomas are defined as tumors more than 7 cm in greatest dimension, which are usually malignant and a very rare endocrine tumor where review of literature showed only 9 reported cases till 2019 from India & 36 cases worldwide) **(Figure 10)**

Case 11

A 47 year old Female patient presented to the Endocrinology OPD was palpitations, muscle cramps, resistant hypertension, generalized fatigue, low grade fever & occasional bouts of nausea & vomiting. Blood tests revealed no such abnormality except hypokalemia & a slightly higher cortisol after an overnight Dexamethasone test (DST) with a slightly higher urinary metanephrines . An ultrasound of the whole abdomen revealed a mass in the left adrenal gland, confirmed by a contrast enhanced computed tomography. Operated for a left adrenalectomy with nephrectomy, the diagnosis of a Schwannoma was estabilised. The patient is now asymptomatic. **(Figure 11)**

DISCUSSION

Ozgur Mete et al [3] elucidates the recent WHO classification of the adrenal tumors bearing nomenclature as the Adreno cortical nodular diseases, based on the usual discovery of functioning nodules which were duly ignored based on the histological pattern , such as Sporadic nodular adreno-cortical disease , bilateral micronodular adrenocortical disease (which sub – classifies itself as primary pigmented nodular cortical disease & isolated micronodular adrenocortical disease) & bilateral macronodular cortical disease along with another segregation of adrenocortical neoplasms with respect to the HISTALDO classification based on the immunohistochemistry namely aldosterone producing diffuse hyperplasia ,aldosterone producing nodule , multiple aldosterone producing nodules , aldosterone producing micronodule , aldosterone producing adrenal cortical adenoma & the aggressive aldosterone producing adrenal cortical carcinoma .to diagnose & treat such lesions, the standard approach would be classifying the lesions as 1. lesions with benign features 2. lesions spanning from 1cm- 4cm 3. lesions > 4 cms using the tools of radiology such as MR imaging, Contrast CT series & the Radioisotope scanning. In our documentation, spanning from The January 2022 – December 2022, we had operated on unilateral & bilateral pheochromocytomas, angiomyolipoma, schwannomas which were sometimes done with nephrectomy, adrenal cysts, non-function adenoma which was surprisingly an accessory spleen & one such case of a unilateral adrenal tuberculosis which bearded resemblance to an adrenal carcinoma. Malgorzata et al [4] writes that the maximum cases would have been adrenal incidentalomas an those who manifest with the symptoms of paroxysm of hypertension , hirsutism, erectile dysfunctions , a phenotype of "hypercortisolism" would be diagnosed as adrenal adenomas (80 %) mostly followed by pheochromocytomas(3–6%), ganglioneuromas, mesenchymal tumors (lipoma, myelolipoma, hemangiomas, sarcomas), lymphomas, cysts, adrenocortical carcinomas (2% - 5 %) & metastatic lesions (1% - 2%) with an additional note that maximum cases would present below 40 years of age. The histopathology parameters that we usually count on are the general histopathological architecture mitotic rates (more than five mitoses per 50 high-power field –HPF would indicate an adrenocortical carcinoma), presence of atypical mitoses, Percentage of clear cells (less than or equal to 25% of tumor), Diffuse architecture, microscopic necrosis, Venous invasion, Sinusoidal invasion &

Capsular invasion. Talking about the biochemistry of such lesions, the European Network for the Study of Adrenal Tumors (ENSAT), would recommend the evaluation of baseline cortisol, ACTH, DHEAS, testosterone,17 hydroxyprogesterone, estradiol, androstenedione with the basic tests focusing on the evaluation of electrolytes , Blood Urea Nitrogen, creatinine, a complete blood hemogram with smear comments, liver function tests to name a few, along with which an initial urinary free cortisol estimation & the dexamethasone suppression test may substantiate the clinical suspicion. With the tools of radiology, triple phase CT scans are a common modality to diagnose such lesions & when the later turns inconclusive, better imaging modality such as the Magnetic resonance imaging by deciphering the variation in the intensities on the T2 weighted images with PET scans using 18 – FDG or a new isotope of interest namely 11 C – METOMIDATE may be used. Grading and staging of such lesion would necessitate the amalgamation of histopathology & radiology with the treatment being cornered to the clinical stigmata & variety of the tumor encompassing surgery as the main tool with the use of radiation or neoadjuvant/adjuvant chemotherapy (Mitotane+_ cisplatin / etoposide based chemotherapeutic agents.

CONCLUSION

Regardless of the above-mentioned cases, as was done in a series of adrenal surgeries by a single surgeon over the last 2.5 years, where the cases have been adequately discussed which did involve both the modalities of a laparotomy & minimal access surgeries, where pheochromocytomas were predominantly found with exceptions as seen, a further study of the adrenal neoplasms would be warranted to suffice & enrich the literature of the same.

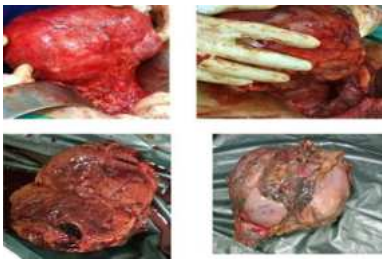

Figure 1 - Figures showing a large mass measuring 8.5x7.2x5.8 cm in the Right adrenal gland diagnosed as Adrenocortical Carcinoma. Picture taken after Right adrenalectomy.

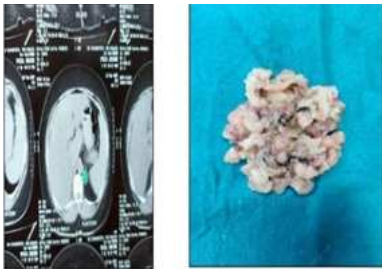

Figure 2 - Figures showing a CECT whole abdomen showing a 3.5X2.8.x3 cm mass (Left) and the same after left adrenalectomy (right).

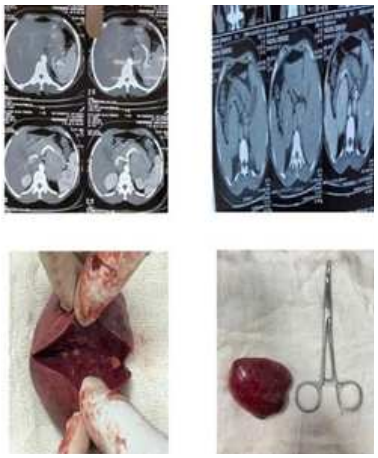

Figure 3 - Upper figures showing a 5.7x3.7x4 cm mass on the left adrenal gland and the lower figures show the same after left adrenalectomy.Surprisingly , on histopathology , this turned out to be an accessory spleen.

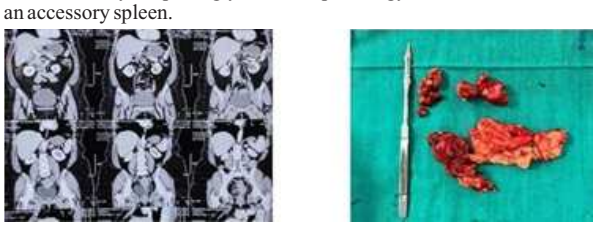

Figure 4 - Figure shows a heterogenously enhancing left adrenal space -occupying lesion (SOL) measuring 5x4x3.9 cm on a CECT whole abdomen (left). the same after left open adrenalectomy with retro peritoneal lymph node dissection. On histopathology, it revealed a case of adrenal tuberculosis.

Figure 5 - Figure showing a left adrenal mass removed after adrenalectomy of 1.7 cm in the greatest dimension, which was an incidentaloma.

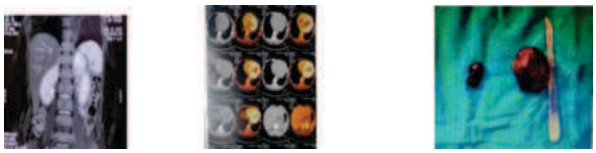

Figure 6- Figures (from left to right) show a space occupying lesion (SOL) of 42x48x47 mm in the left adrenal gland on CECT whole abdomen , a Bilaterally active metabolic adrenal Space occupying lesion on a PET - CT whole abdomen ,specimen of the right adrenal medullary nodule & the left adrenal SOL.

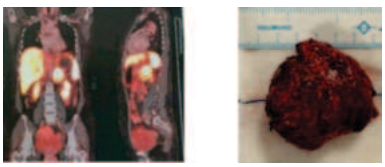

Figure 7- Figures (left to right) showing a 68-Ga-DOTA-NOC-PET-CT whole abdomen showing increased uptake at the left suprarenal gland, the specimen of left adrenal SOL after adrenalectomy.the histopathology revealed a paraganglioma.

Figure 8- Figures showing Space occupying lesion (SOL) in the right adrenal gland which was diagnosed as a endocyst of echinococcus granulosus after a negative echinococcus serology.

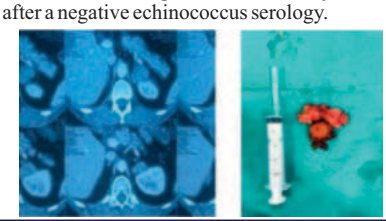

Figure 9- Figures (Left to right) showing a CECT whole abdomen with a heterogeneously enhancing mass at the left adrenal gland, the specimen after left adrenalectomy measuring 33x26x30 mm.The histopathology shows a mixed cortico-medullary tumour of the left adrenal gland.

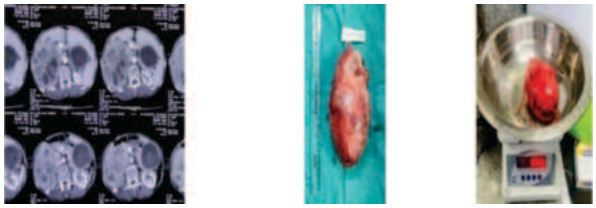

Figure 10- Figures (left to right), showing a triphasic MDCT showing a heterogeneously enhancing space occupying lesion (SOL) of the right adrenal gland showing both solid and cystic components, specimen showing 17x12x8 cm after adrenalectomy , the weight of the specimen was 820 grams. This was a case of a giant pheochromocytoma.

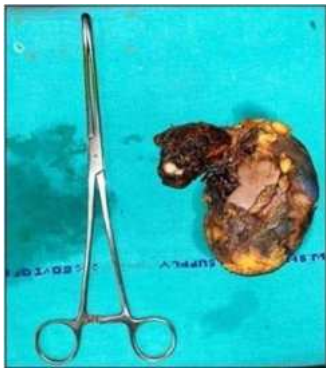

Figure 11- Figure showing a mass in the left adrenal gland , operated and diagnosed as a Schwannoma.

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