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Giant Adrenal Neuroblastoma in Adults: Surgical Management and Comprehensive Review

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ABSTRACT

Neuroblastoma (NB) is a rare solid tumor of the sympathetic nervous system, primarily occurring in children and rarely in adults. Its extracranial origin stems from the medullary region of the adrenal gland or sympathetic ganglia. We report an 18-year-old female who presented with a 6-month history of abdominal swelling and tenderness. Imaging revealed a large retroperitoneal mass causing significant displacement of adjacent structures. Following multidisciplinary optimization, a huge tumor was successfully resected surgically. Histopathology confirmed the diagnosis of adrenal NB. The patient underwent adjuvant chemotherapy and remained symptom-free with favorable outcomes during a 9-month follow-up. This case underscores the importance of comprehensive diagnostic evaluation and multimodal management in treating rare adult adrenal NB.

1 | Introduction

Adrenal neuroblastoma (NB) is a rare tumor of the autonomic nervous system arising from primordial neural crest cells [1]. While common in children, it is exceedingly rare in adults, with an estimated incidence of 1 in 10 million adults per year [2]. Prognosis in adults is poorer compared to children, with 5-year survival rates of approximately 36.3% in adults versus 85% in pediatric cases [3]. Moreover, the clinical manifestations are often nonspecific [4].

Adult NBs may present with distinct systemic symptoms such as hypertension and diaphoresis, which are less common in pediatric cases [5]. Measuring urine catecholamine levels is essential in individuals presenting with diaphoresis, tachycardia, or hypertension, as these symptoms might occasionally be accompanied by systemic signs such as fever or weight loss [6]. Diagnosis can be challenging due to these nonspecific presentations and the lack of standardized treatment protocols for adults [7].

Comprehensive evaluation with imaging, laboratory tests, and pathological examination is crucial to avoid misdiagnosis and assess the feasibility of surgical treatment in suspected cases.

In this report, we discuss a rare case of adult adrenal NB presenting with features mimicking pheochromocytoma. A review of the literature is included to highlight diagnostic challenges, treatment considerations, and outcomes.

2 | Case Presentation

We report the case of an 18-year-old African female who presented with a 6-month history of painless abdominal swelling.

Summary

- Adult adrenal neuroblastoma is an exceptionally rare condition. Its diagnosis is greatly facilitated by advanced imaging techniques.
- Surgical resection remains the cornerstone of treatment for localized disease, while multimodal strategies, including chemotherapy and radiotherapy, should be tailored to address the disease's aggressive nature and stage.

The swelling progressively increased in size until it became grossly visible and later developed into intermittent, severe pain that disrupted her daily activities. She also reported associated symptoms of loss of appetite and early satiety. However, she denied experiencing nausea, vomiting, difficulty passing stools, blood in the stool, or jaundice. Her past medical history was unremarkable, and she was otherwise healthy.

Three months before admission, the patient began experiencing severe frontal headaches that were gradual in onset, throbbing in nature, and nonradiating, with no specific periodicity. The headaches were relieved by opioids and were accompanied by nonexertional palpitations and excessive generalized sweating.

The patient reported a history of fearful episodes but denied any loss of consciousness, confusion, seizures, memory loss, or blurred vision. She also reported a normal sleep pattern and no abnormalities in her micturition history. She was a nonsmoker, nonalcoholic, normotensive, and nondiabetic, with no family history of malignancy. Her body mass index was 20.3 kg/m^2.

Physical examination revealed excessive sweating and tachycardia, with no facial or lower limb edema. Her blood pressure was 159/95 mmHg, her pulse rate was normal, and her ECOG performance status was grade 1. Abdominal examination showed an asymmetric right-sided distension that moved with respiration, with no visible superficial veins, peristalsis, or Sister Mary Joseph nodules.

A palpable, mobile abdominal mass was noted, tender on deep palpation, irregularly shaped, smooth-surfaced, and firm in consistency. The mass extended from the right hypochondriac region to the right lumbar and umbilical regions, measuring approximately 10 × 10 cm below the right subcostal margin. It was restricted in upward movement but mobile downward.

Tender hepatomegaly, measuring approximately 4.5 cm from the right costal margin, was present, with no palpable lymph nodes. The right kidney was ballotable, while the left kidney was not. The spleen and bladder were not palpable. Bowel sounds were normal, and no vascular bruits were detected over the mass. The patient denied bone pain or muscle weakness. Digital rectal and vaginal examinations were unremarkable.

3 | Investigations and Treatment

Laboratory investigations revealed normal electrolyte levels, moderate anemia with hemoglobin of 8.5 g/dL, and a normal platelet count of 350×10^9/L. Renal and liver function tests were within normal limits, as were thyroid and coagulation profiles. Cortisol levels were slightly elevated at 39.6 μg/dL. Neuroendocrine workup indicated elevated levels of 24-h urine vanillylmandelic acid (VMA) at 28.48 mg/L, 24-h epinephrine excretion at 358 nmol, 24-h dopamine excretion at 549 nmol, and 24-h metanephrine excretion at 283 nmol. The VMA-to-creatinine ratio was also elevated at 32.57 mg/g creatinine. Cardiac evaluation, including ECG and echocardiography, revealed normal findings, with an ejection fraction of 79%. Based on her classic triad of symptoms and elevated catecholamine levels, pheochromocytoma was initially suspected.

A contrast-enhanced abdominal-pelvic CT scan revealed a large, right-sided, heterogeneously enhancing retroperitoneal mass that displaced the right kidney, inferior vena cava (IVC), aorta, and right renal artery medially and inferiorly, while extending anterosuperior to the liver and gallbladder (Figure 1A–C). The mass exhibited a diffuse central area of necrosis with a few calcific foci, measuring 6.3 × 12.1 cm, consistent with a large right adrenal tumor (Figure 2). A metastatic work-up, including a CT scan of the chest, showed normal findings (Figure 3).

The patient was optimized for surgery by a multidisciplinary team, including endocrinologists, cardiologists, anesthesiologists, and surgeons. Her blood pressure was stabilized in the ward using alpha and beta blockers, specifically 40 mg of phenoxybenzamine twice daily and 40 mg of propranolol once daily. She also received adequate intravenous fluids prior to surgery.

A chevron incision was performed, and an anterior transperitoneal approach was utilized. Intraoperatively, a large, well-circumscribed adrenal tumor was identified, surrounded by normal adrenal tissue and Gerota's fascia, located just above the upper pole of the right kidney. The tumor adhered to the posterior surface of the right hepatic lobe, displacing the IVC and aorta medially (Figure 4A–C). Adequate exposure was achieved via the Cattell-Brash maneuver to facilitate extensive dissection, as the tumor was significantly large. The tumor was firmly adhered to surrounding structures, requiring mobilization of the hepatic flexure inferiorly and retraction of the liver superiorly. The falciform ligament was ligated bluntly, and the second part of the duodenum, along with the IVC, was mobilized. The tumor exerts medial pressure on the IVC, as shown in Figure 5.

The right adrenal vein was identified as it coursed from the inferomedial border of the right adrenal gland into the right renal vein, ligated, and divided. The right kidney was separated from the tumor by blunt dissection. The tumor was then excised en bloc (Figure 6A), and hemostasis was secured. Estimated blood loss was 100 mL. Throughout the procedure, blood pressure fluctuations remained minimal and within the normal range.

Gross histopathological examination of the surgical specimen (Figure 6B) revealed an adrenal mass measuring 14 × 17 × 13 cm.

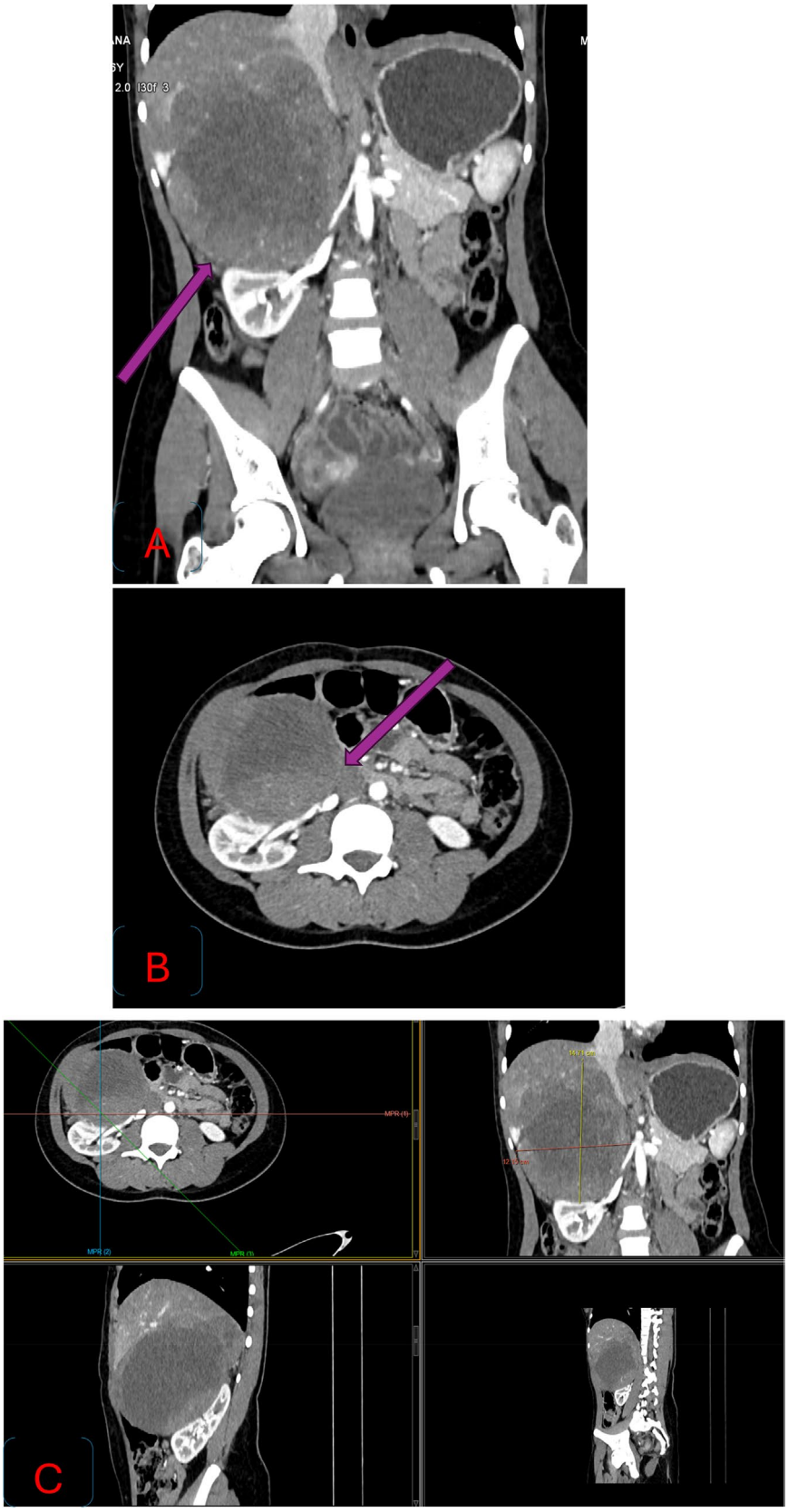


FIGURE 1 | (A–C) Abdominal-pelvic contrast-enhanced CT scan in coronalaxial, and sagittal views showing a large right-sided retroperitoneal mass with heterogeneous enhancement. The mass is displacing the right kidney, inferior vena cava (IVC), aorta, and right renal artery anterosuperiorly, causing medial displacement of the liver and gallbladder. No evidence of vascular involvement is observed.

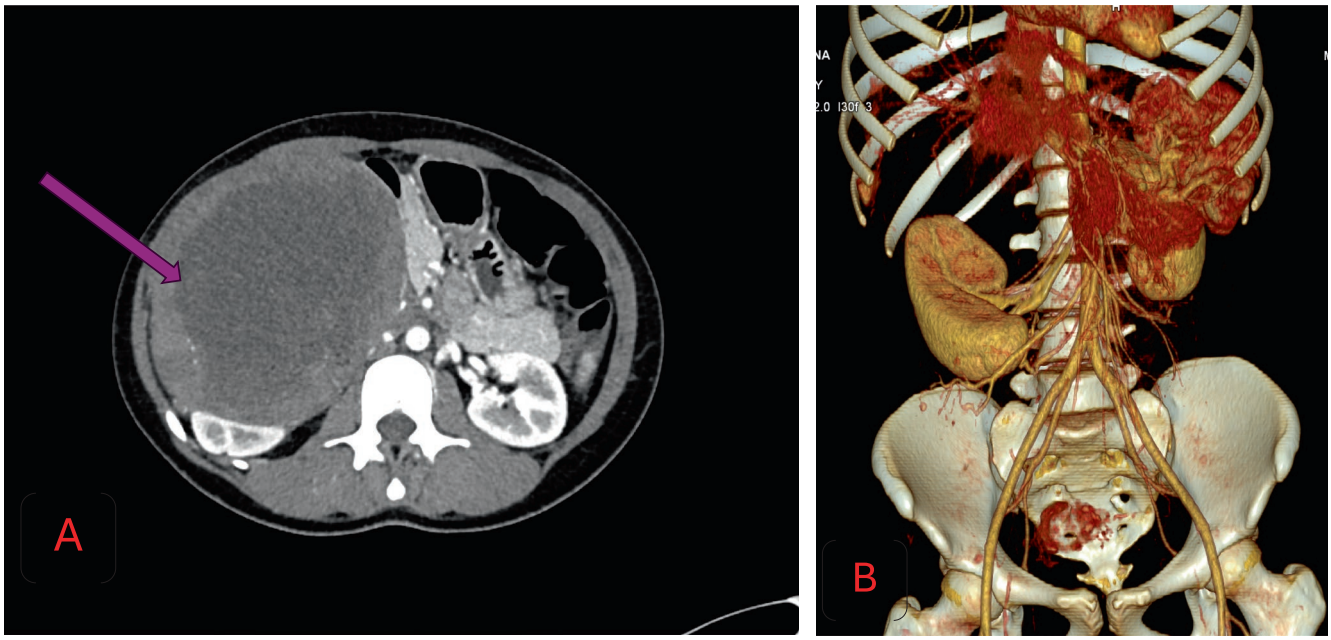


FIGURE 2 | (A) Shows the mass with a diffuse central area of necrosis and several calcific foci; the mass measures 6.3 × 12.1 cm, consistent with a large right adrenal tumor. (B) Volumetric rendering of a CT coronal view showing a mass effect on the right kidney with clear separation from the tumor.

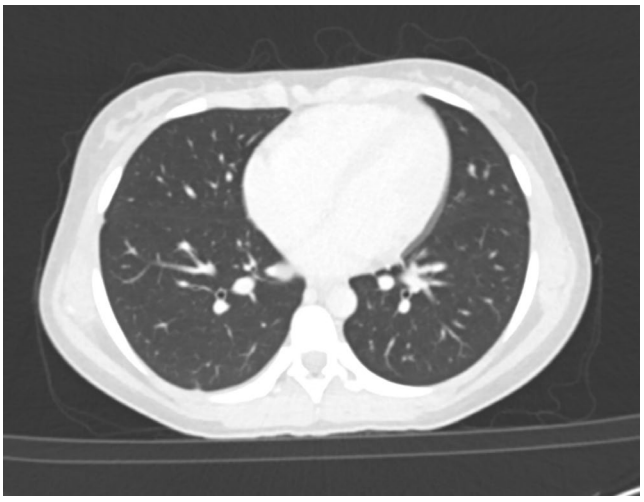


FIGURE 3 | Normal CT chest scan showing no evidence of lung metastasis.

Microscopic analysis demonstrated tumor tissue arranged in nests and a trabecular pattern, consisting of large, pleomorphic, hyperchromatic cells with coarse chromatin and prominent nucleoli, surrounded by abundant eosinophilic cytoplasm. Areas of fibrosis and hemorrhage were also noted. Additionally, abnormal mitosis, capsular invasion, and extensive necrosis were observed (Figure 7A–G).

Due to the lack of available facilities in the country, a metaiodobenzyl-guanidine (MIBG) scan could not be performed postoperatively. NB should be considered in the differential diagnosis of adrenal masses in adults. This case represents the first reported instance of an adult adrenal NB of this size. Imaging plays a critical role in the diagnosis, as adrenal localization is common. Elevated levels of blood and urine catecholamine metabolites may be present and can lead to symptoms such as hypertension, which may mimic the clinical features of pheochromocytoma or paragangliomas.

The aggressive nature of the disease and the lack of established treatment guidelines for adult NB contribute to a poor prognosis for patients over the age of 15. Surgical management is recommended for local control of the disease. Multimodal treatment strategies may offer long-term, favorable oncological outcomes. Treatment outcomes are multifactorial, and our patient was referred to an oncologist for adjuvant therapy 2 months after surgery. She received three cycles of combined carboplatin and etoposide therapy over a 4-month period. Radiotherapy was withheld due to the Stage 1 classification and to minimize the risk of future radiotherapy-induced toxicities. Given the rarity of this diagnosis in adults, 9 months of follow-up post-surgery, the patient remained symptom-free with good surgical outcomes.

4 | Discussion

Neuroblastoma encompasses a group of neuroblastic tumors, including ganglioneuroblastomas and ganglioneuromas, originating from precursor neural crest cells. Primarily a pediatric malignancy, NB is rarely seen in adults, with its incidence sharply declining after infancy. Fewer than 10% of cases occur by age 14, and the disease is exceedingly rare in adults, with an annual incidence of 0.12 cases per million [7, 8]. Adult NBs are often aggressive, with invasive growth and metastatic potential, resulting in a significantly poorer prognosis compared to pediatric cases [9].

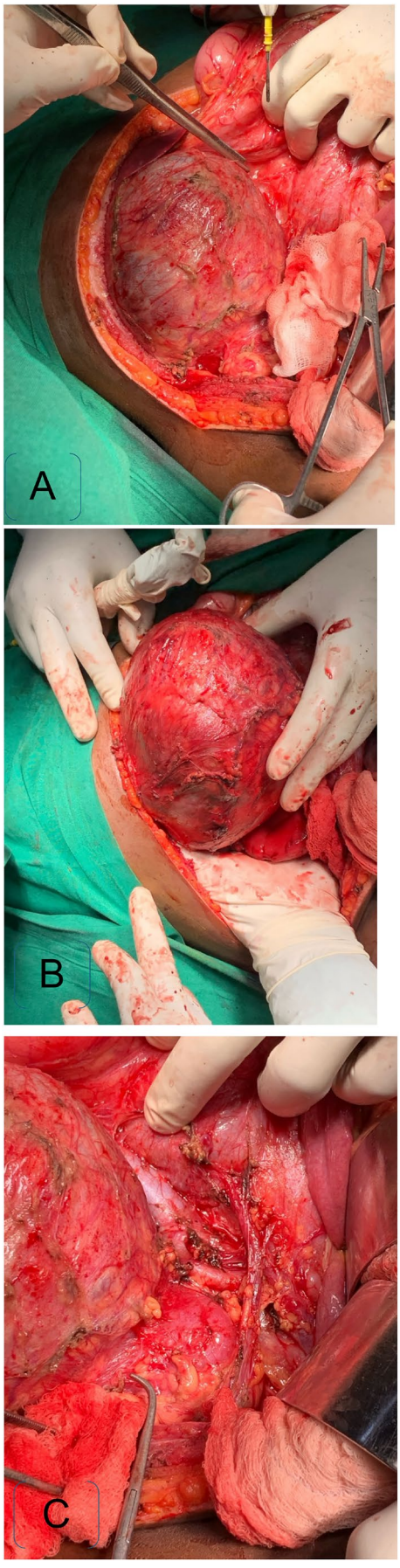


FIGURE 4 | (A–C) Shows a large, well-circumscribed adrenal tumor surrounded by normal adrenal tissue, with Gerota's fascia (A) located just above the upper pole of the right kidney and adhering to the posterior aspect of the right liver lobe (A, B). The mass is pushing the IVC and aorta medially (C).

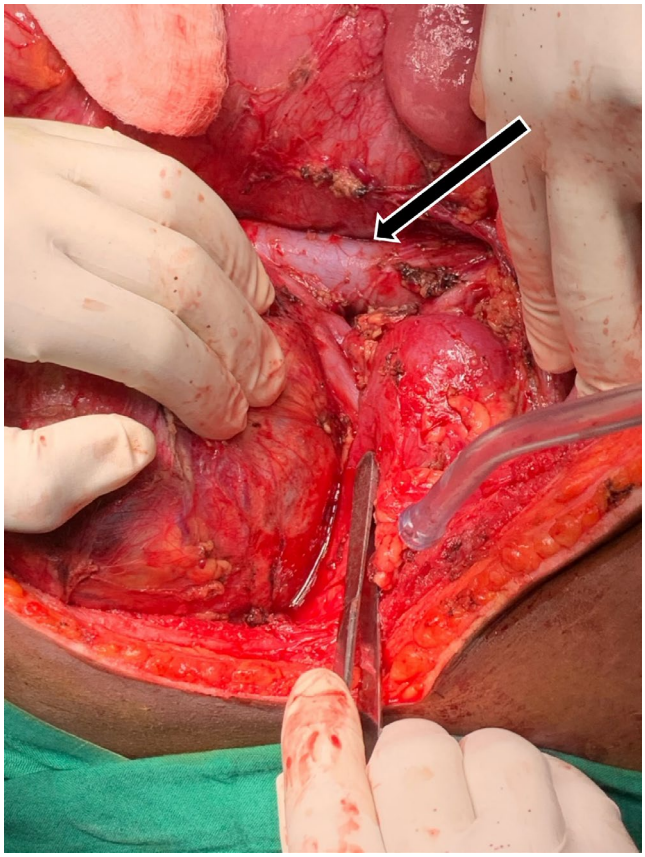


FIGURE 5 | Shows the tumor compressing the IVC medially (black arrow).

The rarity of NB in adults may be partially attributed to its tendency for spontaneous regression or downstaging during adolescence, leaving a limited number of cases to inform adult-specific treatment protocols. Consequently, adult patients are typically managed using pediatric guidelines, though a formal consensus has yet to be established [7].

Both NB and pheochromocytomas arise from neural crest cells but exhibit distinct features. Pheochromocytomas are benign tumors of chromaffin cells, typically occurring in adults aged 30–50 years. These tumors are characterized by excessive catecholamine production, leading to adrenergic symptoms such as sustained hypertension and paroxysmal hypertensive episodes [10, 11].

NB primarily affects the adrenal glands (~40%) and paraspinal ganglia (~25%), with fewer occurrences in the retroperitoneum (~15%), mediastinum (~10%), and other sites (~10%) [12].

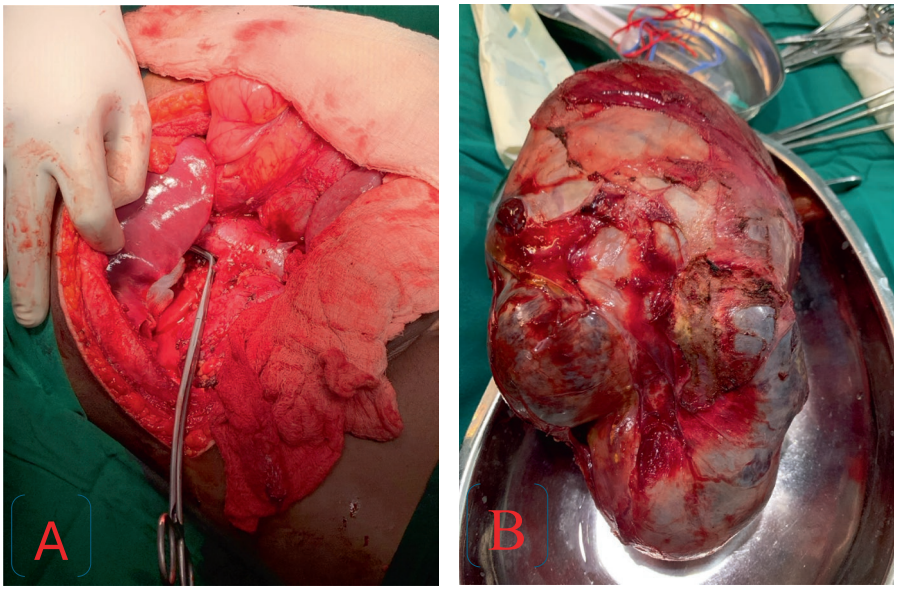


FIGURE 6 | (A) Shows the right kidney separated from the tumor by blunt dissection. The giant tumor was then removed freely. (B) Shows the large tumor being removed.

Symptoms depend on tumor location and may include abdominal distension or a palpable mass, often accompanied by abdominal pain [2, 13]. Paraneoplastic syndromes, such as opsomyoclonus and Kerner-Morrison syndrome (watery diarrhea from VIP hypersecretion), are also reported in rare cases [1, 14, 15]. In our patient, however, no paraneoplastic syndromes were observed.

4.1 | Imaging and Diagnosis

Contrast-enhanced computed tomography (CECT) is instrumental in planning surgical intervention, providing detailed information on tumor density, local invasion, and metastasis. Typical CT findings for NB include a heterogeneous mass with calcifications, necrosis, and hemorrhage [15]. The lesion can also cross the midline and involve other anatomic compartments and generally encase and displace structures rather than invade them [14], which was quite similar to our patient's radiological findings. Magnetic resonance imaging (MRI) is preferred for tumors of spinal origin, while radiolabeled meta-iodobenzyl guanidine (MIBG) scans and technetium 99m (99mTc) methylene diphosphonate bone scans are highly sensitive and specific for detecting bone or bone marrow involvement [16]. Ultimately, a definitive diagnosis requires histological evaluation.

4.2 | Staging and Prognosis

The International Neuroblastoma Risk Group (INRG) staging system is essential for stratifying risk and guiding treatment based on factors such as age, tumor stage, histology, MYCN status, and molecular markers. While surgery alone suffices for very low- and low-risk cases, intermediate- and high-risk NBs require a combination of surgery, chemotherapy, and radiotherapy. Despite advances, adult patients with high-risk NB still face poor outcomes, with 5-year survival rates remaining around 36.3% [17].

4.3 | Management

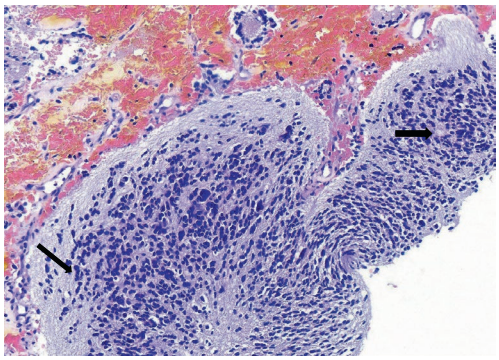
The management of NB demands a multimodal approach. Surgery is crucial for local disease control, often combined with chemotherapy and, in some cases, Iodine-131-MIBG therapy. Preoperative alpha-adrenergic blockade is vital to prevent hypertensive crises during surgery. Phenoxybenzamine, a nonselective alpha-blocker, is preferred for its longer half-life compared to selective agents like prazosin [18].

4.4 | Surgical Approaches

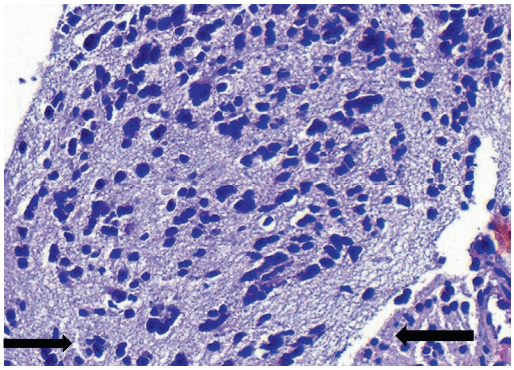
Minimally invasive techniques, such as laparoscopic transperitoneal adrenalectomy and retroperitoneoscopy, have revolutionized the surgical management of adrenal tumors. Evidence from large clinical series has demonstrated their efficacy and safety, even in complex cases [19, 20]. These approaches are particularly advantageous in reducing patient morbidity, shortening hospital stays, and expediting recovery times compared to open surgeries. Evidence supports their efficacy and safety even in technically challenging cases. For instance, Conzo et al. highlighted the effectiveness of laparoscopic adrenalectomy in managing pheochromocytomas, emphasizing its role in reducing perioperative complications and improving surgical outcomes [21].

Retroperitoneoscopy offers a direct approach to the adrenal glands, bypassing extensive mobilization of intra-abdominal structures. This is particularly advantageous in patients with previous abdominal surgeries or significant adhesions. Coppola Bottazzi et al. have demonstrated its utility even in rare cases such as adrenal oncocytic neoplasms, where its prognostic impact was notable, especially in elderly populations. This highlights the expanding applicability of minimally invasive techniques to complex adrenal pathologies [22].

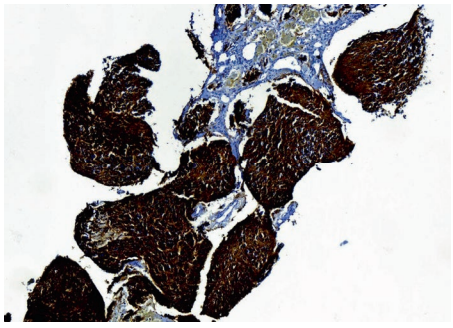
For complex adrenal pathologies, including large NBs or tumors with local invasion, the choice between laparoscopic and open



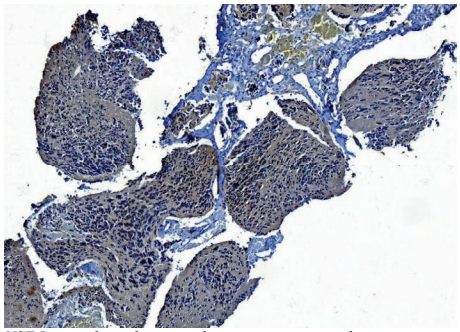
A. *A core tissue biopsy with a small round cell tumor in trabecular pattern with few scattered pseudo rosettes (black arrows) x20*



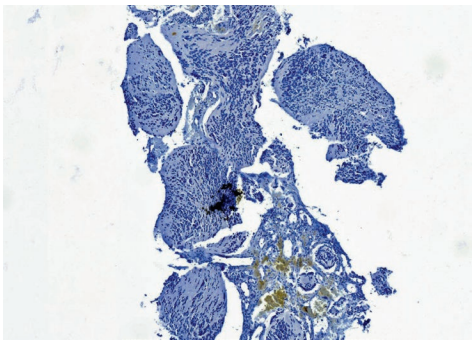
B. *Tissue section shows small to medium sized cells with hyperchromatic nucleus and inconspicuous nucleoli and areas with neuroblasts (black arrows) seen with a background of neuropil stroma*



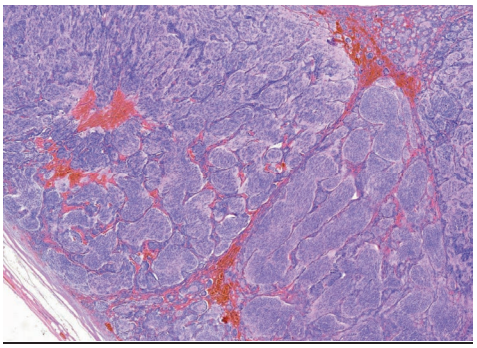
C. *Synaptophysin Immunohistochemistry showing strong positive cytoplasm staining*



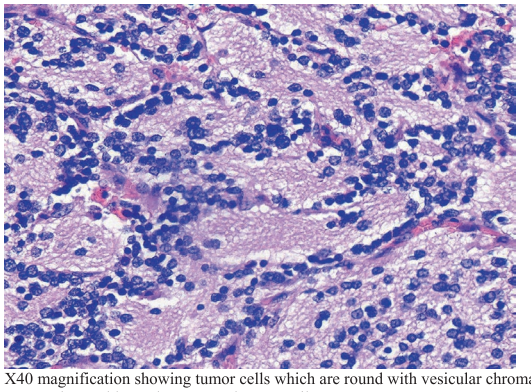
D. *NSE Immunohistochemistry showing positive cytoplasmic staining.*



E. *EMA Immunohistochemistry showing negative results.*



F. *A capsulated tumor in nests and trabecular pattern with areas of hemorrhage in between. X10*



G. X40 magnification showing tumor cells which are round with vesicular chromatin, scattered neuroblasts also seen and a neuropil stroma

FIGURE 7 | (A) A core tissue biopsy with a small round cell tumor in a trabecular pattern with few scattered pseudo rosettes (black arrows) ×20. (B) Tissue section shows small to medium sized cells with hyperchromatic nucleus and inconspicuous nucleoli and areas with neuroblasts (black arrows) seen with a background of neuropil stroma. (C) Synaptophysin immunohistochemistry showing strong positive cytoplasmic staining. (D) NSE immunohistochemistry showing positive cytoplasmic staining. (E) EMA Immunohistochemistry shows negative results. (F) A capsulated tumor in nests and a trabecular pattern with areas of hemorrhage in between ×10. (G) ×40 Magnification showing tumor cells which are round with vesicular chromatin, scattered neuroblasts are also seen and a neuropil stroma.

approaches must be guided by tumor size, extent of local invasion, and surgeon expertise. Conzo et al. demonstrated that long-term outcomes for laparoscopic adrenalectomy in conditions like Cushing's disease are favorable, reinforcing the need to consider these techniques in carefully selected patients [23]. Advanced energy devices, such as ultrasonic and bipolar systems, improve surgical precision and minimize blood loss, particularly in larger tumors [24].

In our patient, the large tumor size and extensive local spread necessitated an open transperitoneal approach. While laparoscopic techniques remain the gold standard for smaller and less invasive tumors, open surgery is often required for larger tumors involving adjacent structures such as the liver, IVC, and renal vasculature.

4.5 | Adjuvant Therapy

High-dose combination chemotherapy is effective for treating advanced primary or metastatic NB, with commonly used agents including cyclophosphamide, iphosphamide, vincristine, adriamycin, cisplatin, carboplatin, and etoposide. Bone marrow ablative therapy with transplantation has also shown utility for high-risk cases [25]. Radiation therapy is beneficial for controlling local relapse rates and should be considered for aggressive or advanced disease [26].

5 | Conclusion

Adult NB remains a rare and challenging diagnosis, requiring a comprehensive evaluation and individualized treatment. Surgical intervention should prioritize complete tumor resection without spillage, while adjuvant therapies should be tailored to the tumor stage and molecular profile. The absence of standardized protocols for adults underscores the need for further research to optimize outcomes for this rare malignancy.

Author Contributions

Charles John Nhungo: conceptualization, investigation, writing – original draft, writing – review and editing. **Doreen Gerion Gilbert:** investigation, methodology, supervision, validation, writing – review and editing. **Boniface Nzowa:** conceptualization, data curation, investigation, supervision, validation. **Philipo Felix:** investigation, methodology, supervision, validation, visualization. **Nimwindael Msangi:** data curation, investigation, methodology, supervision. **Theoflo Mmbando:** supervision, writing – review and editing. **Gabriel Mtaturu:** conceptualization, supervision, visualization, writing – review and editing. **Obadia Nyongole:** supervision, validation, visualization, writing – review and editing. **Charles A. Mkony:** supervision, writing – original draft, writing – review and editing.

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Disclosure

This report has been published in accordance with the CARE criteria.

Ethics Statement

This case report study was exempt from ethical approval at our institution, as this paper reports a single case that emerged during normal surgical practice.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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