American Journal of Biomedical and Life Sciences
2026, Vol. 14, No. 3, pp. 41–44
https://doi.org/10.11648/j.ajbls.20261403.12

Case Report

Anaesthetic Challenges in Management of Robotic Bilateral Cortical Sparing Adrenalectomy and Paraganglioma Excision in a Pediatric Patient

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Abstract

Pheochromocytoma accounts for 0.5% to 2% of pediatric hypertension, detected in children between 6 and 14 years of age. As compared to adults, in children it is commonly associated with genetic syndromes or familial diseases such as Neurofibromatosis, Von Hippel Lindau disease and Multiple Endocrine Neoplasia (MEN) type 2A and type 2 B. Diagnosis is by blood biochemistry, CT, Meta- iodobenzylguanadine (MIBG) scan. Complete surgical resection is the definitive treatment. Robotic approach benefits early recovery, minimal tissue handling thereby minimal blood pressure fluctuations. Anaesthetic goal is perioperative blood pressure control, restoration of blood volume, management of arrythmias. Minimally invasive surgery (MIS) does not mean minimally invasive anaesthesia. There are concerns of anaesthesia such as physiological effects of pneumoperitoneum, absorption of carbon dioxide, positioning of patient during surgery, docking and undocking of robotic arms and associated hemodynamic changes. This unique case report aims to describe the clinical presentation, anaesthetic management in a 14-year-old child undergoing robotic bilateral cortical sparing adrenalectomy and paraganglioma excision. We highlight the challenges associated with labile hemodynamics and technical robotic concerns of anaesthesia in pediatric patients. Multidisciplinary approach in tertiary hospital having a Da Vinci Robot, advance monitoring resources and intensive care unit aid in favorable outcome. Genetic screening and counseling facilitate early diagnosis and prevents recurrence.

Keywords

Bilateral Pheochromocytoma, Paraganglioma, Robotic Surgery, Anaesthetic Management, Pediatric

1. Introduction

A 14-year-old male child weighing 58.8 kg was posted for robotic bilateral adrenalectomy with excision of paraganglioma. This child was incidentally diagnosed with pheochromocytoma during his work up for circumcision surgery, when his blood pressure was detected as 170/120 mmHg and he had no associated symptoms such as headache, diaphoresis, palpitations. Family history revealed that his mother had undergone adrenalectomy for pheochromocytoma. The diagnosis was confirmed with MRI showing bilateral suprarenal mass and a small presacral mass at S1 level medial

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Received: 28 April 2026; **Accepted:** 18 May 2026; **Published:** 4 June 2026

to right internal iliac artery. This right and left adrenal mass measured 6 x 2.9 x 3.5 cms and 5.3 x 3.7 x 3.7 cm (AP X TR X CC) respectively. MIBG scan showed increased uptake confirming bilateral pheochromocytoma diagnosis further supported by elevated levels of urinary nor-metanephrine (Refer Table 1). His blood biochemistry which included complete blood count, serum creatinine, aldosterone and cortisol levels were within normal limits. ECG was unremarkable, 2 D echo showed left ventricular hypertrophy. Multidisciplinary team involving endocrinologist and cardiologist optimized his blood pressure to 110/70 mmHg in a month with tab nifedipine 10 mg once daily, tab prazosin 5mg twice daily and tab metoprolol 50 mg twice daily. He was electively scheduled for robotic bilateral cortical sparing adrenalectomy and paraganglioma excision under general anaesthesia. After obtaining parent's written consent for surgery and overnight starvation, he received his regular dose of tab prazosin and metoprolol on the day of surgery.

Plan was general anaesthesia with endotracheal intubation and controlled ventilation using muscle relaxant, invasive intraarterial monitoring and fluid management with central venous pressure monitoring. Patient was wheeled in operation theatre standard monitors (ECG, pulse oximeter, capnograpgh, temperature) were attached and peripheral line was secured with 20-gauge cannula and balanced salt solution started. Premedication with i.v pantoprazole and i.v midazolam 1 mg was administered. His preoperative blood pressure was 110/70 mmHg, pulse rate 96/min. General anaesthesia was induced using i.v fentanyl 80 mcg, i.v propofol 120 mg and i.v cisatracurium 10 mg. Before intubation i.v xylocard 60 mg was given. Radial artery cannulation followed thereafter. Anaesthesia maintained with air: oxygen 50: 50, sevoflurane and atracurium infusion. i.v dexmedetomidine was started at 1 mcg/kg/hr. and nitroglycerin (NTG) at 0.5 mcg/kg/min. After creating the pneumoperitoneum and maintaining intraabdominal pressure at 14 mmHg the ports for the robotic arms were inserted patient was then given right lateral decubitus for left adrenalectomy. Da Vinci robotic arms were then docked on to the inserted ports. Hemodynamics was stable during docking. At the time of tumor handling and ligation of adrenal vein there was acute rise in the blood pressure up to 275/140 mmHg. This was treated with increasing the NTG dose (1mcg/kg/min), aliquots of i.v fentanyl 20 mcg and transiently increasing the dose of dexmedetomidine (up to 1.5 mcg/kg/hr) till the blood pressure stabilized. Brief episodes of bigeminy were treated with i.v metoprolol up to 2 mg in titrated dose till normal sinus rhythm was established. As soon as the tumor was ligated and dissected there was an episode of hypotension (systolic blood pressure 80 mmHg) with normal sinus rhythm. i.v NTG and dexmedetomidine was stopped and fluid boluses were given also 100ml of 20% albumin was given. In addition, noradrenaline was started at 0.05 mcg/kg/min.

After left adrenalectomy robot was undocked, patient was made supine for excision of paraganglioma. Redocking of robotic arms was done to the same ports and paraganglioma was excised. During this part of the surgery noradrenaline (0.05 mcg/kg/min) was continued and there was not much hemodynamic instability considering as an inactive (silent) tumor.

Robot was again undocked and new ports were inserted for right adrenalectomy. Left lateral decubitus was given and robotic arms were docked again. Noradrenaline was stopped as there was slight increase in the blood pressure to 180/110 mmHg during the dissection of the tumor. This was successfully treated with NTG (0.1 mcg/kg/min and boluses of i.v fentanyl 20 mcg.

The total duration of surgery was 12 hours, blood loss was 500 ml and urine output was adequate. Temperature was maintained and blood sugar was normal throughout the surgery.

At the end of surgery with patient still in lateral decubitus, ultrasonography guided quadratus lumborum block with 20 ml of 0.25% bupivacaine was administered for postoperative analgesia. Patient was then made supine and extubated after adequate reversal of neuromuscular blockade. All the inotropic support was discontinued and patient shifted to ICU for observation. Postoperative stay was unremarkable. Patient was off antihypertensive drugs and discharged on day 5.

2. Investigations

Table 1. *Blood biochemistry of our patient.*

TESTS	RESULTS	NORMAL RANGE
Free plasma Normetanephrine	3996 ncg/l	< 195 ncg/l
24 hrs. Urinary Normetanephrine levels	5772 mcg/24 hr.	< 600 mcg/24 hr.
Normetanephrine: Creatinine ratio	6937.5 mcg/gm creatinine	102-262 mcg/gm creatinine
Vanillylmandelic acid	37.28 mg/24 hrs.	0-18 mg/24 hrs.
Aldosterone	13.6 ng/dl	1.76- 23.2 ng/dl

3. Discussion

Pheochromocytoma and paraganglioma are diseases in childhood. Typically, it presents in 6 to 14 years of age with male preponderance. It is commonly associated with familial diseases such as Neurofibromatosis, Von Hippel Lindau disease and Multiple Endocrine Neoplasia (MEN II A and B) [1]. This familial association differentiates the paediatric population from an adult pheochromocytoma [1]. Our patient was 14-year-old boy and his mother had been diagnosed and operated for pheochromocytoma. The child's genetic screening diagnosed his disease as Von Hippel Landau condition.

Clinically the patients present with headache, sweating, diaphoresis, palpitations, fatigue. Adults exhibit paroxysmal hypertension (50% of the cases) whereas sustained hypertension in 60-90% of paediatric patients [2]. Our patient had high blood pressure (170/120 mmHg) but asymptomatic. Clinical manifestations in these patients are due to catecholamines mainly normetanephrine which activates alpha and beta receptors causing hypertension, increased cardiac output due to renin secretion. Some patients may even present with life threatening complications like cardiomyopathy, ventricular failure, myocardial infarction and arrythmias [2].

The gold standard for diagnosis is elevated levels of free metanephrine and normetanephrine in plasma and urine. An elevation of these analytics greater than four-fold above reference values confirms the diagnosis [3] as seen in Table 1. Noradrenergic pheochromocytoma/paragangliomas secrete norepinephrine and metanephrine as seen in Von Hippel disease and many tumours associated with familial paraganglioma syndrome [3]. Imaging studies with CT scan, MRI helps in localization of tumours and detecting extra-adrenal and metastatic lesions. MIBG is a highly specific test that confirms the catecholamine secreting nature of tumours and location of extra adrenal tumours which was positive in our patient. Recently PET imaging with somatostatin analogue (Ga- DOTA-SSA, F-F DOPA) has shown excellent diagnostic results [4]. CT scan of 4 patients revealed bilateral adrenal masses and paragangliomas at sacral level. Paraganglioma showed no uptake of MIBG indicating a silent tumour. Paragangliomas have been traditionally classified as biochemically 'silent' tumours [5]. The treatment of pheochromocytoma and paraganglioma is surgical resection once the blood pressure is optimized. The biggest challenge during surgery is the hemodynamic instability intraoperatively, that is hypertension at the time of tumour handling and hypotension after tumour resection. To minimize these blood pressure fluctuations, it is essential to control the blood pressure with antihypertensives at least 2-4 weeks before the surgery in paediatric patients as against 1-2 weeks in adult patients [6]. It took one month to optimize the blood pressure of our patient. Selective alpha 1 antagonist is the preferred drug due to its less postoperative incidence of hypotension. Drugs like phenoxybenzamine, prazosin, doxazosin, terazosin are commonly used [2]. Our patient was on tab prazosin 5mg twice a daily. Recommended dose is 0.5 -1mg/day every 4- 6 hrs and titrate to a maximum of 20-24 mg/day [7]. Beta receptor antagonist if started before alpha blockers would lead to cardiac insufficiency and pulmonary oedema. Cardio selective blockers are desirable and have lesser side effects. Our patient was on beta blocker tab metoprolol 50 mg twice daily and tab nifedipine 10 mg once daily. Calcium channel blockers are also used to control blood pressure especially in patients with paroxysmal hypertension [7]. Sometimes tyrosine hydroxylase inhibitor{metyrosine] is recommended night before the surgery [3, 10]. But because of its side effects of sedation, diarrhoea, extra pyramidal effects and unclear utility in paediatric patients it is not routinely recommended [3]. An unusual and unique aspect in management of hypertension in catecholamine secreting tumours is increasing the water and salt intake. The rational is to increase the blood volume, reverse the chronic vasoconstriction and ultimately prevent the post resection hypotension [6, 7].

Robotic approach for resection of pheochromocytoma and paraganglioma gives added advantage of better dexterity, improved surgical exposure and reduced soft tissue dissection, early mobilization and less postoperative pain. In addition, robotic approach in paediatric patients presents various unique challenges like size of patients against size of the robot, patient positioning, limited patient access, physiologic changes due to carbon dioxide insufflations [8].

In our case scenario, the complete case was conducted with robotic assistance in total duration of 12 hours during which the position of the patient was changed four times along with docking and undocking of robotic arms each time. Positioning itself may cause injuries hence we had cushioned the pressure points at the arms, wrists and hands to prevent inadvertent nerve injury. Given the fixed nature of the robotic instrument and the operating console it is mandatory to maintain deep level of neuromuscular blockade in order to avoid any organ or vascular injury in the event of inadvertent movement of the patient [9].

The intraabdominal pressures maintained during pneumoperitoneum was 14-16 mmHg with no evidence of carbon dioxide retention as seen in arterial blood gas analysis and end tidal capnometer. To mitigate the effect of carbon dioxide insufflation, the ventilation was on pressure-controlled volume guaranteed mode with the addition of positive end expiratory pressure (PEEP).

The main objective in anaesthesia management is to prevent factors that may cause sudden rise in blood pressure due to catecholamine upsurge. This was avoided in our patient by giving anxiolytic on arrival in operation theatre and inserting invasive lines after general anaesthesia. Drugs like ketamine, ephedrine are avoided due to their sympathomimetic effects [10].

Other factors which may cause sudden rise in blood pressure includes laryngoscopy and intubation response, creating pneumoperitoneum, repeated change in position with docking

undocking of robotic arms, surgical handling of tumour. Appropriate measures need to be taken during above conditions by using drugs like glyceryl trinitrate, sodium nitroprusside, metoprolol, esmolol, labetalol, phentolamine, nicardipine, magnesium sulphate, maintain good depth of anaesthesia using dexmedetomidine, opioids [11].

The second intraoperative challenge is the hypotension seen after tumour removal. This is caused due to sudden fall in catecholamine levels, prolonged postoperative residual effect of preoperative alpha blockers and contracted blood volume due to vasoconstriction [10]. In our patient similar hypotension was treated with bolus of crystalloid and colloid (20% albumin) as well as by starting noradrenaline (0.5 mcg/kg/min). Since the blood loss was tolerable and haemoglobin was maintained blood transfusion was avoided. Other vasopressors like vasopressin can also be used in addition to noradrenaline.

As surgery was cortical sparing adrenalectomy our patient did not require long term steroid replacement therapy [3].

As this surgery was performed solely robotic assisted the postoperative pain was negligible, hence patient could be extubated immediately. Giving regional block replaced cumbersome procedure of epidural placement.

Abbreviations

MEN	Multiple Endocrine Neoplasia
MIGB Scan	Meta Iodo-benzyl Guanidine Scan
MIS	Minimally Invasive Surgery
AP	Antero Posterior
TR	Transverse
CC	Cranio Caudal
i.v.	Intravenous
NTG	Nitro Glycerine
Ga-DOTA-SSA	Gallium -68 DOTA Somatostatin Analogue
FF-DOPA	Fluro 3, 4-dihydroxy Phenyl Alanine

Author Contributions

Nishigandha Girish Sawant: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Writing – original draft, Writing – review & editing

Vijay Lokayya Shetty: Conceptualization, Data curation, Supervision, Writing – review & editing

Anita Rajeev Chhabra: Conceptualization, Data curation, Resources, Writing – review & editing

Saurabh Ramesh Patil: Conceptualization, Validation

Conflicts of Interest

The authors declare no conflicts of interest.

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