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Anaesthetic Management for a Patient with Pheochromocytoma: A Case Report

Anestezijska obravnava bolnika s feokromocitomom. Prikaz primera

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Abstract

Pheochromocytoma (PCC) is a rare neuroendocrine (catecholamine-secreting) tumour of the adrenal gland. Anaesthetic management during surgery can be challenging due to perioperative haemodynamic instability. We report a 58-year-old male patient with right adrenal gland PCC who underwent surgical excision under general anaesthesia (GA). Preoperatively, the patient's high blood pressure (BP) was adequately controlled with α-adrenergic blockers. Intraoperative haemodynamic fluctuations during tumour manipulation were managed pharmacologically with esmolol and remifentanil, while hypotension following tumour excision was treated with intravenous fluids and vasopressors. Postoperatively, the patient was transferred to the intensive care unit (ICU) for monitoring and pain management, where he made an uncomplicated recovery. Comprehensive preoperative preparation and close intraoperative communication with surgeons allow anaesthesiologists to anticipate and prevent major haemodynamic instability and cardiovascular complications during PCC excision.

Izvleček

Feokromocitom (PCC) je redek nevroendokrini tumor nadledvične žleze, ki izloča kateholamin. Izvajanje anestezije med operacijo je lahko zahtevno zaradi možne perioperativne hemodinamske nestabilnosti. Poročamo o primeru 58-letnega moškega bolnika s PCC desne nadledvične žleze, ki je bil operiran v splošni anesteziji (GA). Pred operacijo je bil bolnikov visok krvni tlak (BP) ustrezno nadzorovan z α-adrenergičnimi blokatorji. Hemodinamska nihanja med odstranjevanjem tumorja so bila farmakološko nadzorovana z esmololom in remifentanilom, medtem ko je bila hipotenzija po odstranitvi tumorja obravnavana z vnosom tekočin v veno in z vazopresorji. Po operaciji je bil bolnik premeščen na oddelek za intenzivno nego (ICU) za spremljanje in lajšanje bolečin, kjer je brez zapletov okreval. Celovite priprave pred posegom in tesno sodelovanje s kirurgi med operacijo omogočajo anesteziologom, da med kirurško odstranitvijo PCC predvidijo večje hemodinamske nestabilnosti in srčno-žilne zaplete in jih lahko preprečijo.

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1 Introduction

Pheochromocytomas (PCCs) are rare neuroendocrine tumours that secrete catecholamines, originating from chromaffin cells in the adrenal medulla. Excess circulating catecholamines typically present as a triad of headaches, palpitations, and diaphoresis, along with sustained or paroxysmal hypertension (1). Diagnosis is established through the measurement of catecholamines and their metabolites in plasma and urine. At the same time, tumour localization is achieved through imaging modalities such as computed tomography (CT) or magnetic resonance imaging (MRI) (2). Definitive treatment involves surgical resection, with preoperative medical optimization to control hypertension using α-adrenergic blockers, sometimes combined with β-adrenergic blockers and calcium channel blockers (3).

2 Case Presentation

A 58-year-old male presented to the emergency department with a constant headache and stabbing abdominal pain radiating to the back. He had a known history of diabetes mellitus and hypertension. Apart from elevated blood pressure (BP), his physical examination was unremarkable. The abdomen was non-tender, with no localized guarding or rebound tenderness. His electrocardiogram (ECG) showed a normal sinus rhythm, and his BP was 140/95 mmHg. A computed tomography (CT) scan revealed a haematoma surrounding a mass in the right adrenal gland and a solid nodular lesion on the left adrenal gland, suspected to be an adenoma. The haematoma was not interpreted as active bleeding. Before discharge from the emergency department, a more detailed magnetic resonance imaging (MRI) and referrals to endocrinology and general surgery were suggested.

In the following days, an MRI confirmed the adenoma on the left adrenal gland and a mass on the right adrenal gland, possibly a PCC. Endocrinology requested 24-hour urine tests for renin, aldosterone, dehydroepiandrosterone sulphate (DHEA-S), metanephrine, and normetanephrine. Results were positive for metanephrine (1433 µg/24 h; normal range: 52–341 µg) and normetanephrine (7350 µg/24 h; normal range: 88–444 µg). With a preliminary diagnosis of PCC, the patient was started on doxazosin 4 mg daily for two weeks, a high-sodium diet, and increased fluid intake to restore intravascular volume.

Cardiology evaluation showed normal ECG, BP 130/80 mmHg, and left ventricular concentric hypertrophy on echocardiography. BP later dropped to 110/70 mmHg. After the final anaesthesiology assessment, the patient was cleared for surgery. Informed consent was obtained.

On arrival to the operating room (OR), monitoring included five-lead ECG, pulse oximetry, non-invasive BP, end-tidal CO_2 ($EtCO_2$), and bispectral index (BIS). Intravenous (i.v.) and arterial cannulations were performed. Premedication included midazolam 2 mg, followed by lidocaine 100 mg and fentanyl 100 µg. Induction with propofol 200 mg was followed by i.v. rocuronium 50 mg for intubation after 2 minutes of mask ventilation. A central venous catheter was then inserted. Anaesthesia was maintained with sevoflurane. Infusions of nitroglycerin, esmolol, norepinephrine, and epinephrine were prepared.

BP rose from 140/87 mmHg to 150/92 mmHg during intubation. An esmolol infusion was initiated. Intraoperative BP fluctuations were managed with norepinephrine, esmolol, and remifentanil (Figure 1). Prior to tumour ligation and excision, in order to prevent hypotension, methylprednisolone 100 mg and crystalloids were given. Surgical exploration showed the adrenal mass contacting the renal artery and encasing the inferior vena cava. Intra-abdominal ultrasonography (USG) confirmed no invasion, thus allowing resection. Aside from mild hypotension post-excision, the patient tolerated the procedure well (Figure 1). A total of 3000 mL of crystalloids and 500 mL of hydroxyethyl starch (HES) were administered. Central venous pressure dropped from 18 to 11–14 cmH_2O.

After reversal with sugammadex, the patient was extubated fully awake and transferred to the ICU with stable vitals. He was moved to the surgical ward on postoperative day one and discharged home on day three. Histopathology confirmed the diagnosis of PCC.

3 Discussion

Pheochromocytomas are rare neuroendocrine tumours of the adrenal glands characterized by excessive catecholamine secretion. They are considered among the most challenging conditions in anaesthetic practice due to the risk of severe haemodynamic instability. High catecholamine levels cause hypertension,

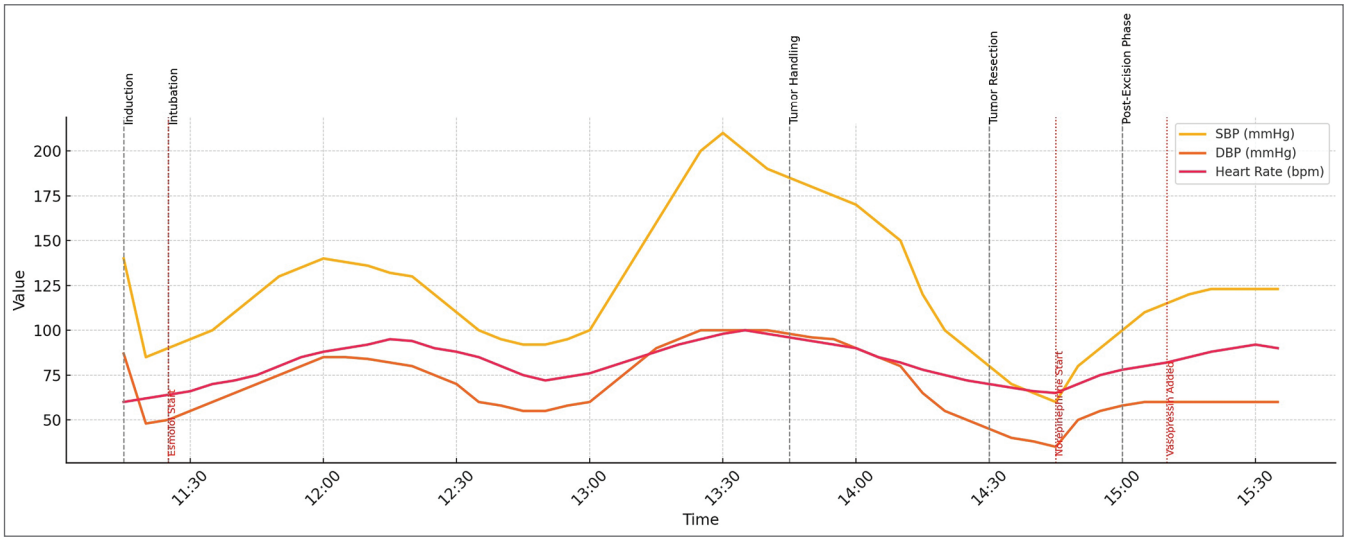

Figure 1: Intraoperative haemodynamic trends in a patient undergoing adrenalectomy for pheochromocytoma.
Blood pressure peaked from 140/87 mmHg during induction to 150/92 mmHg during intubation, prompting initiation of esmolol infusion. Tumour manipulation led to severe hypertension (SBP 210 mmHg), followed by rapid hypotension (SBP 60 mmHg) post-resection. Surgical phases (grey dashed lines) and pharmacologic interventions (red dotted lines) are annotated. Values are derived from intraoperative invasive arterial pressure monitoring records.
Source: archive of the Department of Anesthesiology and Reanimation, Baskent University, Ankara.

tachyarrhythmias, hypovolemia, hyperglycaemia, myocardial remodelling, and eventual heart failure. Prolonged hypertension may lead to organ damage of the heart, kidneys, and central nervous system (CNS) (2).

Preoperative planning requires multidisciplinary coordination, including endocrinology, cardiology, anaesthesia, and surgery. Cardiac evaluation involves ECG to detect arrhythmias and ischemia, and echocardiography to assess cardiac function (systolic/diastolic dysfunction related to persistent hypertension or cardiomyopathies due to toxic catecholamine exposure) (4). Management goals include BP and heart rate control, normalization of glucose and electrolyte disturbances, and volume repletion (5).

Though no established guidelines or randomized controlled studies (RCTs) exist, preoperative pharmacological treatment is a widely accepted strategy for reducing the risk of intraoperative haemodynamic instability (6). Phenoxybenzamine, a non-selective α-adrenergic blocker, and newer selective α-adrenergic blockers such as prazosin, terazosin, and doxazosin are used to achieve preoperative α-adrenergic blockade. Selective α-adrenergic blockers have advantages over phenoxybenzamine: they do not produce reflex tachycardia, have a shorter half-life, and dosage can be adjusted rapidly to avoid preoperative and postoperative hypotension. However, van der Zee et al. found no conclusive superiority in their review (7). In our patient, doxazosin was used. β-blockers may be added for tachycardia, but only after adequate α-blockade. β-1 adrenergic suppression with unopposed α-receptor overstimulation can lead to acute cardiac insufficiency and pulmonary oedema. Patients are advised to increase oral salt/sodium (5-10 grams) and water (2-3 litres/day) intake (6). A 5-10% fall in haematocrit is expected with proper hydration. If that goal is not achieved, volume expansion with NaCl 0.9% (2 litres/day i.v.) is administered two days before surgery (6).

From the anaesthesiology perspective, surgery for PCC has two distinct haemodynamic phases: the hypertensive phase (induction/intubation and tumour handling, which may cause sympathetic stimulation and catecholamine secretion) and the hypotensive phase (post-resection catecholamine withdrawal) (6). General anaesthesia (GA) with or without epidural anaesthesia (EA) is common. EA is added to achieve optimal postoperative analgesia. Additionally, sympathectomy resulting from EA can blunt haemodynamic instability during induction; however, vasodilation caused by EA may potentiate hypotension after tumour excision and in the postoperative period (8). EA was not used in our case due to the lack of cooperation.

In addition to standard American Society of Anesthesiologists monitoring (pulse oximetry, electrocardiogram, EtCO2), a BIS monitor is used to determine the depth of anaesthesia. Following premedication with

benzodiazepines, evaluating anaesthesia depth with BIS and invasive (arterial) BP monitoring is crucial to prevent haemodynamic stress. BIS monitoring facilitates the precise titration of anaesthetic agents during both induction and maintenance, ensuring optimal hypnotic levels while avoiding oversedation. This dual monitoring approach is particularly critical during pheochromocytoma resection, as maintaining an adequate yet stable depth of anaesthesia helps mitigate catecholamine surges and prevents intraoperative haemodynamic instability (4,10). GA can be safely induced with either propofol or etomidate, while ketamine should be avoided due to its sympathomimetic effect (4). Adjuncts like fentanyl, lidocaine, and esmolol blunt sympathetic response during laryngoscopy and endotracheal intubation (9). GA for pheochromocytoma surgery can be maintained using either TIVA or inhalational agents. A recent study by Weingarten et al. found that TIVA was independently associated with more intraoperative hypertensive episodes compared to inhalational anaesthesia during adrenalectomy, potentially due to differences in anaesthetic depth control (11). Among volatile anaesthetics, sevoflurane is preferred due to its favourable haemodynamic profile and lack of arrhythmogenic effect, while desflurane and halothane are avoided due to sympathetic stimulation (12).

During dissection and tumour manipulation, quickly titratable and shorter-acting agents such as nitrates (nitroglycerin and sodium nitroprusside), Ca++ channel blockers (nicardipine), and β-blockers (esmolol) are used to control the hypertension (4).

Following tumour resection, the sudden withdrawal of catecholamines causes a fall in systemic vascular resistance. Fluid loading to rapidly expand intravascular volume and counteract hypotension can be done with crystalloids, colloids, plasma expanders, and blood products (13). Central venous pressure (CVP) can guide fluid administration (14). Excess volume replacement may be ineffective in correcting hypotension and may precipitate pulmonary oedema in patients with cardiac insufficiency (12). Alternatives for guiding volume resuscitation include pulmonary artery catheters and intraoperative transoesophageal echocardiography (TEE) (4). If fluid expansion is ineffective, vasoconstrictor infusion is initiated. Norepinephrine is first-line; vasopressin may be added for refractory hypotension (12). The rationale for adding vasopressin is that it does not rely on peripheral adrenergic receptors for its pressor effect, making it a good alternative to norepinephrine. If refractory hypotension persists after fluid and vasoconstrictor therapy, i.v. methylene blue may be considered (4).

Postoperatively, ICU monitoring is required. Hypotension is common due to preoperative α-blockade and catecholamine withdrawal following tumour excision. Fluid loading and vasopressors are often required temporarily to counteract hypotension. Catecholamine withdrawal leads to rebound hyperinsulinemia and, together with depleted glycogen stores, can cause hypoglycaemia—frequent glucose monitoring (every 1–2 hours) is mandatory for the first 24 hours.

While this case report highlights key anaesthetic strategies for pheochromocytoma resection, it is important to note the limitations of current evidence. The absence of large-scale randomized controlled trials (RCTs) comparing preoperative α-blockers or anaesthetic techniques limits the ability to establish standardized protocols. Most recommendations are derived from observational studies and expert consensus, underscoring the need for further high-quality research to validate optimal management approaches.

4 Conclusion

Pheochromocytomas are rare catecholamine-secreting tumours that present significant challenges in anaesthesia due to the risk of life-threatening intraoperative cardiovascular instability. Preoperative optimization through a multidisciplinary approach is essential to reduce the risk of organ dysfunction. Intraoperative management requires advanced haemodynamic monitoring and access to vasoactive agents to manage sudden BP fluctuations.

Thorough preoperative planning involving endocrinology, cardiology, anaesthesia, and general surgery, and close intraoperative communication are critical for ensuring patient safety and minimizing complications. Successful outcomes rely on vigilance, teamwork, and evidence-based anaesthetic strategies.

Conflict of interest

None declared.

Inform consent of the patient

The patient gave informed consent for the publication of his/her case.

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