Case Report

Catecholamine induced lactic acidosis after a laparoscopic resection of Pheochromocytoma

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Abstract

Pheochromocytomas are catecholamine secreting tumors of the adrenal medulla, and most commonly originate from adrenal gland. Most tumors secret large amount of norepinephrine, and epinephrine to a lesser extent. The clinical presentations are due to the over activity of catecholamines. Classical presentations are paroxysmal or sustained hypertension with palpitations, headaches and profuse sweating. Both open and laparoscopic approaches are used for the tumor resection. Anesthetist pays a significant role in the peri-operative management. Hyperlactaemia and lactic acidosis can be complications of the surgery. This can have a significant impact on the outcome.

Key words

Anesthetic, Laparoscopic, Pheochromocytoma, Catecholamines, Sever hyplerlactaemia, Lactiac acidosis.

Introduction

Pheochromocytomas are catecholamine secreting tumors of the adrenal medulla, and most commonly originate from adrenal gland. Most tumors secret large amount of norepinephrine, and epinephrine to a lesser extent. The clinical presentations are due to the over activity of catecholamines. Classical presentations are paroxysmal or sustained hypertension with palpitations, headaches and profuse sweating. Both open and laparoscopic approaches are used for the tumor resection. Anesthetist pays a significant role in the peri-operative management. Hyperlactaemia and lactic acidosis can be complications of the surgery. This can have a significant impact on the outcome.

This case illustrated a management of laparoscopic adrenalectomy of a patient who developed sever lactic acidosis after tumor handling

Case Report

A 67 year old male patient (weight 61 kg) was admitted for investigation of evening pyrexia of two months duration. All the basic investigations were normal, but ultra sound scan of the abdomen revealed a left suprarenal mass, confirmed by a CT scan of the abdomen. Except hypertension he did not experience headache, palpitation, sweating, weight loss or tremors suggestive of pheochromocytoma. Urine 24 hour meatanephrine level was 1.6 mg/24 hours (Reference range up to 1 mg/24 hours) and vanylyl mandelic acid level was 13.5 mg/24 hours (Reference range 1-11). Both values were higher than normal. Adrenal cortical hormonal levels (Aldosterone, plasma cortisol, plasma testosterone level) were within normal limits. Blood pressure was under control with losartan. He was discharged and readmitted to the surgical for laparoscopic adrenalectomy.

Patient was given Phenoxybenzamine (alpha blocker) for 10 days preoperatively, starting with 8 mg 12 hourly and gradually increasing up to 8 mg 8 hourly. Blood pressure was stabilized at a normal level (Systolic BP 110 to 80 mmHg and Diastolic BP 70 to 50 mmHg).Operation was planned on the 10th day of phenxybenzamina, and the last dose was given in the night before the surgery. He was admitted to the high dependency unit for close monitoring of blood pressure. Diazepam 10mg was given in the night and morning to relieve the anxiety. Patient was minimally fasted, well hydrated with oral and IV fluids before the surgery. Lying down and standing blood pressures were 130/80mmHg and 110/70mmHg receptively. Heart rate was 87/min. Surgical procedure was explained in detail and informed consent was taken for an epidural with general anesthesia.

In the operating theatre, routine monitoring was commenced with five lead ECG, noninvasive blood pressure and pulse oximeter. He received 2 mg of intravenous midazolam and 50microgram of fentanyl. Initial blood pressure and heart rate were 160/90mmHg and 92beats/min respectively. While the patient is sitting an epidural catheter was placed at lower thoracic level. Left radial arterial line was inserted under local anesthesia. Before induction of anesthesia invasive blood pressure was 176/106mmHg. Magnesium sulphate 2g was infused over 20 minutes. Fentanyl bolus of 200 microgram and a remifentanil infusion was titrated to achieve a systolic blood pressure of 100-110 mmHg. General anesthesia was induced with propofol, patient was intubated after 3 minutes of atracurium. Maximum blood pressure raise after intubation was 140/90mmHg and heart rate remind between 80-90 bpm.

Anesthesia was maintained with isoflurane. Central line was inserted after induction and showed initial reading of 12mmHg.Ventilation was adjusted to maintain a normal $ETCO_2$.

Before the skin incision MAC was increased up to 2. Systolic Blood pressure and CVP increased up to 170 mmHg and 17mmHg respectively following the creation of pneumoperitoneum. Remifentanil infusion was increased to reduce the blood pressure to 140 mmHg. Transperonial

laparoscopic resection of left adrenalectomy was performed. Significant fluctuation of blood pressure was occurred during the handling of the tumor. In addition to remifentanil and inhalation agent, a GTN infusion and intermittent boluses of propofol were used to reduce blood pressure to 120-140 mmHg. Blood pressure fluctuation reminded for about 30 minutes. Following tumor resection, GTN infusions was omitted and Norepinephrine infusion was started .Central venous pressure was maintained between 12-15 mmHg.Throughout the surgery core temperature was maintained between 36 -37 ˚C with the use of forced air and fluid warmers. Even though initial blood gases were normal blood gases after resecting the tumor revealed pH 7.32, PCO_2 30 mmHg, HCO_3 - 15 mmol/l. Lactate level had increased to 8.0 mmol/l irrespective of adequate fluids, good temperature control. A total of 2000ml of warm normal saline was used during the surgery. Blood loss was 350ml and urine out-put was maintained >0.5ml/kg/h. Immediate extubation could not be done due to reduce consciousness, extubation was delayed till the metabolic derangement are corrected. Patient was extubated after overnight ventilation. Blood pressure was maintained with minimum dose of noradrenaline, blood gas was normal with a lactate level of 2.0mmol/l. He was discharged from the ICU on the second day and from the hospital on day 5.

Surgical Procedure

The surgery was performed in right lateral decubitus position and head end elevated to 30 degrees. Five ports were used including the camera port. Intra-abdominal pressure was maintained at CO_2 at 14mmHg. The splenic flexure and descending colon were mobilized to expose the left kidney. Gerotas fascia was opened towards upper pole and left renal vein defined. The enlarged left adrenal gland was identified and dissection performed using bipolar diathermy and ultra-sonic dissector. The left adrenal vein draining in to the left renal vein was clipped and divided. The dissection was completed and the left adrenal tumor was retrieved in a bag.

Discussion

Pheochromocytoma presentation and diagnosis

Pheochromocytomas are neuroendocrine tumors originate from adrenal medulla. Rarely, they originate from extra adrenal chromaffin tissue. Up to 25% of the pheochromocytomas are familial. Clinical feature are due to secretion of catecholamimes, mostly noradrenaline. Classical symptoms are due to over activity of catecholamines. Hypertension associated with palpitation, headache and diaphoresis are considered four classical symptoms. However, their presentation is highly variable and can mimic other diseases [1]. If remained undiagnosed they can lead to life threatening complications. The diagnosis of pheochromocytoma depends mainly upon the demonstration of catecholamine excess by 24 hours urinary catecholamines and metanephrines or plasma metanephrines [1]. Tumors are localized by a computed tomography scan and magnetic resonance imaging of the adrenal glands and abdomen. Computed tomography scan are commonly used due to excellent spatial resolution for thorax, abdomen, and pelvis [1].

Pre-operative BP control and optimization

Pre-operative assessment and optimization are key elements for a successful surgery. The objective of the preoperative care include control of blood pressure, restore the chronic volume depletion, heart rate and arrhythmia control, optimization of myocardial function, reversal of glucose and electrolyte disturbances [7]. Primary cause for hypertension is alpha rector activation due to noradrenaline. Patient can have normal blood pressure with paroxysmal hypertension or they may have persistently high blood pressure with or without paroxysmal episodes. Alpha receptor antagonists are used as the initial therapy to control the hypertension. Phenoxybenzamine is a non-selective, irreversible alpha receptor antagonist which is being used over many years. It is initiated at doses of 10 mg every 6–12 h and increased to 30–40 mg every 6 h to a maximum dose of 240

mg/day. Headache, drowsiness, orthostatic hypertensions and dizziness are complication of phenoxibezamine. Prazosin, doxazosin, and terazosin are non-selective alpha receptor blockers. There are several studies comparing selective and non-selective alpha blocker therapy to control the blood pressure. Phenoxybenzamine is associated with superior intraoperative hemodynamic stability, but causes more post-operative hypotension and adverse drug effects. No studies indicate a difference in clinical outcomes between phenoxybenzamine and selective alpha-antagonists [8]. Medial management should be considered for 7-14 days until optimal alpha blockage is achieved. Alpha blockers should be started first followed by beta blockers to prevent reflex hypertension [10]. Labetalol and esmolol are commonly used non selective beta blockers both can be used before and during the surgery [9]. Chronic catecholamine over activity contract the intravascular volume. Treatment should also include high sodium diet and adequate fluid intake to prevent the hypotension after tumor resection [10]. Minimum fasting and administration of normal saline overnight prevent post tumor resection hypotension. There are multiple studies to define the goals of alpha blockage therapy. However the end points of alpa blockage is not clearly mentioned due to extreme variability of patients. Some commonly accepted goals in the pre-operative optimization are [10]; systolic blood pressure <160 mmHg, diastolic blood pressure <90 mmHg; Heart rate <80 min, orthostatic hypertension with a blood pressure of >80/45 mmHg and normal ECG rhythm without ischemic changes. Not like other surgeries, prior preparation is mandatory. Fluctuation of blood pressure should be avoided to prevent associated complications. Patient anxiety, surgical or anesthetic interventions can leads to hypertension. Anxiolytics are used in the night and morning to reduce the anxiety. Benzodiazepines are commonly used for this purpose.

Open vs laparoscopic surgeries

Tumor resection is the treatment of choice for adrenal tumors. This can be done either by open laparotomy or laparoscopically. Due to the significant complexity associated with the surgery, experience surgeon should be involved in the procedure. There are multiple evidence that laparoscopic surgery is safe as open laparotomy for resection of adrenal pheochromocytomas [2].

First the diagnostic laparoscopy is performed to rule out local tumor invasion Number of subcostal ports used can be varied from 4-5 according the experience, size, location and the facilities available. Early ligation and division of the adrenal vein is carried out prior to gland manipulation and dissection when possible.

Dissection of left side tumors are technically difficult than the right side tumors. First the splenic flexer and colon is mobilized to gain access to splenorenal ligament. A complete medial rotation of adjacent structures was critical to provide adequate exposure of the adrenal gland and vein. Gerota fascia is incised to gain access to left adrenal vein and adrenal gland. The vein is then lighted and divided at its junction with left renal vein.

Both right and left adrenal dissections, the borders of the adrenal gland are first identified and then dissected away from the retroperitoneum, using periadrenal fat as a “handle”. The large glands are usually resected with peri adrenal fat. The glands are never grasped to avoid hemodynamic liability, troublesome bleeding or tumor disruption. Endovascular steppers are used to clamp and divide with stapler if veins are larger. Specimens can be retrieved with a extraction bag through the trocar site

Inflation of CO2 cause significant increase in serum catecholamine levels [3, 4]. This is due to either direct compression or change in tumor perfusion. Additionally, hypercapnia and acidosis are two known stimuli for catecholamine release and hypertension [5]. As

CO_2 causes increase in catecholamine release, helium has been suggested as an alternative [6].

Anesthesia and surgery

All patients need general anesthesia with or without regional analgesia. Apart from the basic monitoring invasive blood pressure monitoring is mandatory in these patients; as intubation, creation of pnuoperitonium, tumor handling causes significant fluctuation of blood pressure. Central venous line helps to guide fluid as well as provide the access to central vascular compartment to infuse vasopressors and vasodilators. Intra-arterial line and epidural can be inserted with mild sedation and analgesia. However recent advances favor minimally invasive methods of cardiac output and stroke volume variation to guide fluid and vasopressors [11].

The main complain anticipated during the surgery is hemodynamic instability, hypertension before and during tumor resection and hypotension after the tumor resection. There are multiple studies of using remifentanil infusion to attenuate the hemodynamic response to anesthesia and surgery. Remifentanil can be easily and safely titrate to achieve the hemodynamic goals. In addition to anesthetic drugs, GTN and sodium nitropresite can be used as vasodilators while esmolol and labetalol can be used as beta blockers [11, 12].

Lactic acidosis

Hyperlactaemia occurs when the lactate generation exceeds lactate consumption. High concentration of epinephrine and norepinephrine have the potential to generate significant hyperlactaemia due to their metabolic and vasoconstrictive effect. Severe lactic acidosis is defined as $pH < 7.35$, bicarbonate <20 mmol/l, and serum lactate ≥ 5 mmol/l. In fact this patient lactate level was increased up to 8 mmo/l. A study carried out in Peking Union Medical College Hospital between 2011 and 2104 demonstrated severe post-operative hyperlactaemia after laparoscopic resection of pheochromocytoma [13].

If not effectively controlled patient can end with lactic acidosis impairing myocardial contractility and cardiac output .Due to the rarity of pheochromocytoma there are few case reports available on post-operative lactic acidosis and laparoscopic adrenalectomy. However, Shubin Wu, Weiyun Chen, Le Shen, et al. have analyzed the risk factors for severe hyperlactaemia in 140 patients who underwent laparoscopic resection of adrenal Pheochromocytoma [13]. Results have revealed Hyperlactatemia is a frequent complication of laparoscopic resection of pheochromocytoma (40.7%); sever hyperlactaemia/ lactic acidosis is also relatively common (15.2%). According to the results, patients with post-operative sever lactic acidosis are likely to experience a longer post-operative hospitalization, a longer duration of mechanical ventilation than those with normolactatemia [14, 15, 16].

Conclusion

A good preoperative preparation optimization, laparoscopic surgery by an experience surgeon, general anesthesia with regional analgesia minimize the hemodynamic fluctuations. Remifentanil can be used effectively to minimize hemodynamic fluctuations. However significant fluctuation of blood pressure can lead to catecholamine surge and severe lactic acidosis. Adequate fluids, minimum fluctuation of blood pressure can avoid significant rise in serum lactate levels. Patient with severe lactic acidosis may need to be supported until their metabolic derangement is corrected. In addition undiagnosed pheochromocytoma, in a patient with peri-operative hypertension, could be reason for severe lactic acidosis provided the other reasons are exclude.

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