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Pheochromocytoma

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Introduction

Topic

- Pheochromocytomas are tumors of the endocrine system, otherwise known as paragangliomas that affect the adrenal medulla (Azadeh, Ramakrishna, Bhatia, Charles, & Mookadam, 2015).
- Wu et al. (2018, p. 1) defines pheochromocytoma as "a tumor deriving from adrenomedullary chromaffin cells that produces one or more catecholamines: epinephrine, norepinephrine, and dopamine".
- This tumor produces catecholamines such as epinephrine and norepinephrine, and can be lethal if un-treated (Azadeh et al., 2015).
- Between 1.5-2.1 million individuals will be affected with the disease and the disease affects 0.1% of the high blood pressure population (Sonntagbauer, Koch, Strouhal, Zacharowski, & Weber, 2018); (Aksakal et al., 2018).
- Pheochromocytoma's diagnosis depends on the clinician's knowledge of the condition combined with computerized tomography (CT) scanning (Mula-Abed et al., 2015) (See Figure 1).

Clinical Relevance

- The importance of proper assessment and diagnosis of individuals with symptomology suggesting pheochromocytoma is paramount.
- The clinical relevance is due to there being a definite risk of undergoing general anesthesia/surgical procedure when afflicted with this disease, since, according to Azadeh et al., (2015), patients with undiagnosed pheochromocytoma, while under the effects of anesthesia, may have a fatal hypertensive crisis.
- There are specific interventions to take as the anesthetist when pheochromocytoma removal is proposed (Sonntagbauer et al., 2018).

Signs and Symptoms

- During perioperative management, it is important to manage symptomology that the patient may experience such as hyperglycemia or fever (Azadeh et al., 2015).
- Common symptoms of the disease can also include include headache, sweating, fluttering in chest, and high blood pressure (Mula-Abed et al., 2015).
- Pheochromocytoma may exhibit primarily with external symptoms of tachyarrhythmias, hypertension, sweating, and headache (Aksakal et al., 2018).
- Langton et al., (2018) proposes immense risk for the pregnant mother and her unborn baby throughout antepartum due to possibility of tachycardia and malignant hypertension
- Wu et al., (2018) studies a case report of a teenager with pheochromocytoma presenting to the emergency department with tachycardia, hypotension, hypoxia, and cough with hemoptysis. This patient also presented with takotsubo cardiomyopathy, diastolic heart failure, upper respiratory tract infection, and acute liver dysfunction.
- Some patients may only have abdominal pain with concurrent distention of the abdomen (Afaneh, Yang, Hamza, Schervish, & Berri, 2017).

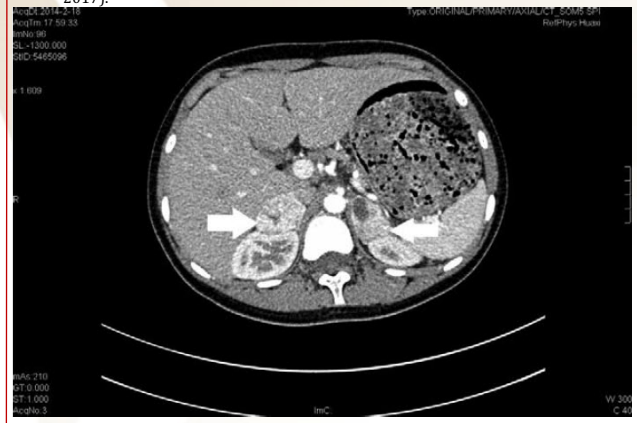

Figure 1. Wu. et al (2018)

Pathophysiology

- Angelousi, Kassi, Zografos, and Kaltsas (2015) associate "genetic alterations of these genes with transcriptome changes" and divide pheochromocytoma into two clusters of genetic disorders (Angelousi, Kassi, Zografos, & Kaltsas, 2015, p. 987).
- Pheochromocytomas are very vascularized, making the patient potentially hemodynamically unstable even if early intervention occurs (Aksakal et al., 2018) (See figure 2).
- Individuals who have pheochromocytoma that go undiagnosed may develop catecholamine crisis, which is a life threatening increase in circulating catecholamines. This can cause dangerous cardiovascular dysrhythmias and contribute to death (Sonntagbauer et al., 2018).
- One way to diagnose the disease is by a metabolized 24-hour urine test that analyzes the urine for catecholamine metabolites. Another test that is more commonly used is the analysis of fractioned catecholamines in the patient's plasma (Mula-Abed et al., 2015).

Implications for Anesthesia Care

- Special consideration should be regarded to those with known diagnosis of pheochromocytoma or those undergoing tumor excision via en bloc resection or adrenalectomy (Aksakal et al., 2018).
- If patients develop hypotension during the case, crystalloid infusion is indicated first, followed by dopamine after excision of the tumor (Aksakal et al., 2018).
- Sonntagbauer et al., (2018) states that propofol may stimulate the sympathetic nervous system due to injection pain. Fentanyl, under certain doses, may elicit a positive inotropic effect. Rocuronium, on the other hand, influences atrial tissue by stimulating norepinephrine release along with stimulation of beta-1 receptors.

Treatment

- According to Azadeh et al., (2015), the adrenergic receptors throughout the body are typically sensitized to the high level of circulating catecholamines and can cause hypotension and/or hypertension. Patients are generally started on high volumes of crystalloid infusions to prevent hypotension. The preferred pharmacological management of the patient involves alpha-blockers, beta-blockers, and calcium channel blockers to maintain normotension and normal resting heart rate. The preferred alpha blocker to achieve normotension is phenoxybenzamine. Secondly, after successful alpha blockade has been initiated, beta-blockers are to be started on a case by case basis. Calcium channel blockers can also be used to prevent coronary artery vasospasm or unintended tachydysrhythmias. "In this situation calcium channel blockers can be used as an adjunct to help control vasospasm as well as tachyarrhythmias" (Azadeh et al., 2015).
- If the tumor is diagnosed in its infancy, simple laparoscopic technique may be indicated (Mula-Abed et al., 2015).
- En bloc technique may also be indicated, with the five year survival rate of over 90 percent if the tumor is benign (Aksakal et al., 2018).
- Complicated cases, possibly related to tumor size, or surgeon preference, may elicit the patient to undergo adrenalectomy to reduce risk of excess catecholamine secretion during surgery (Chung et al., 2018) (See figure 3).
- The role of the anesthetist is to prevent concurrent hemodynamic instability throughout the case and to assure that pre-operative medications were administered appropriately and in the correct timeframe (Wolf et al., 2019) (See figure 4).
- Special consideration is to be undertaken when tumor size is <6cm in diameter along with urinary catecholamine values higher than the maximum value of 2000 ug/24 hour period (Aksakal et al., 2018).

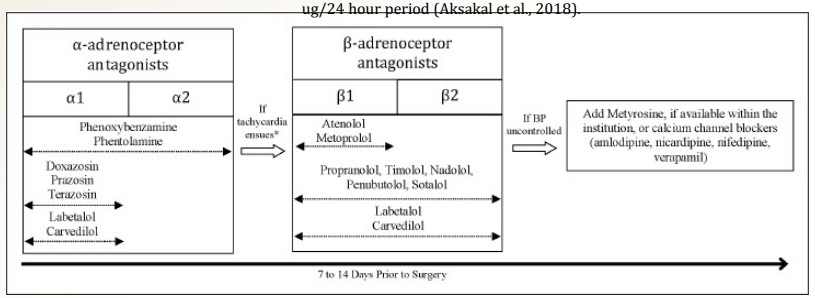

Figure 4. Wolf. et al (2019)

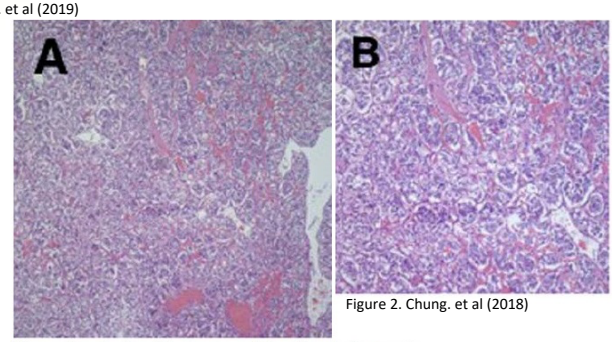

Figure 2. Chung. et al (2018)

Microscopic evaluation of the tumor revealed small nests of tumor cells surrounded by capillaries (H&E stain; a: ×100; b: ×200).

Conclusion

- Pheochromocytoma presents with unusual symptomology and can remain difficult to diagnose.
- Early detection is paramount along with pre-surgical pharmacological intervention for best outcomes.
- Decrease manipulation of tumor to avoid additional secretion of catecholamine (Chung et al., 2018).
- From an anesthesia perspective, pheochromocytomas in patients presents a severe risk to the preservation of life pre, intra, and post-operatively.
- It remains necessary to prevent hemodynamic instability and to prevent administration of drugs which may elicit hemodynamic instability, since prolonged hemodynamic instability may lead to loss of life or chronic disability (Sonntagbauer et al., 2018).

Patient demographics and tumor characteristics	n = 51 (%)
Age (years)	52.0 ± 1.6
Sex	
Male	25 (49)
Female	26 (51)
BMI (kg/m²)	23.3 ± 0.3
ASA score	
I, II	41 (80.3)
III	10 (19.7)
Circumstances of tumor detection	
Symptoms from hormonal secretion	26 (51)
Incidentaloma	25 (49)
Previous diagnosis of hypertension	27 (52.9)
Duration of antihypertensive medication (months)	24.1 ± 6.3
Tumor laterality	
Right	22 (43.1)
Left	29 (56.9)
Tumor size (cm)	5.6 ± 0.3
Preoperative urinary catecholamines and metabolites	
Epinephrine (µg/day)	182.6 ± 75.0
Norepinephrine (µg/day)	756.5 ± 344.5
Metanephrine (mg/day)	6.4 ± 1.2
VMA (mg/day)	17.6 ± 4.0

Figure 3. Afaneh, Yang, Hamza, Schervish, & Berri (2017)

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