Anesthetic Management for Laparoscopic Adrenalectomy of Pheochromocytoma

An Essay
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By

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Mohamed Ragheb Taha Abdelghaffar

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List of Abbreviations

ACE	: Angiotensin converting enzyme
ACTH	: Adrenocorticotropic hormone
ADH	: Antidiuretic hormone
CAMP	: Adenosine cyclic monophosphate
COMT	: Catechol-O-methyl transferase
CRH	: Corticotropin-releasing hormone
CT	: Computed tomography
CVD	: Cyclophosphamide, Vincristine, Dacarbazine
DHEA	: Dehydroepiandrosterone
DHEAS	: Dehydroepiandrosterone sulfate
DOPA	: Dihydroxyphenylalanine
ECG	: Electrocardiogram
FFA	: Free fatty acids
MAC	: Minimal alveolar concentration
MAO	: Monoamine oxidase
MEN	: Multiple endocrine neoplasia
MIBG	: Meta-iodobenzylguanidine
MRI	: Magnetic resonance imaging
NF	: Neurofibromatosis
PAOP	: Pulmonary artery occlusion pressure
PET	: Positron emission tomography
PNMT	: Phenylethanolamine-N-methyl transferase

List of Abbreviations (Cont.)

PTHrP	: Parathyroid-related peptide
VHL	: Von Hippel Lindau
VMA	: Vanilly mandelic acid

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Introduction

Pheochromocytoma is a rare catecholamine secreting tumor arising commonly from adrenal medulla. It has got multidimensional challenging aspects in spite of our improved understanding of its physiological and clinical behavior during surgical resection. This neuroendocrine tumor is associated with a most unpredictable and fluctuating clinical course during anesthesia and surgical intervention ***(Manger et al., 1994).***

Pheochromocytomas are tumors usually characterized by secretion of catecholamines and associated signs and symptoms of catecholamine excess. This secretion can arise in a sudden burst leading to paroxysmal symptoms. The classical symptom triad consists of palpitations, headaches and sweating lasting from only minutes to hours and occurring periodically on different occasions ***(Manger et al., 1996).***

The incidence of pheochromocytoma is very low (2 people/million/year) with most tumors occurring between ages 20 and 50 years. Pheochromocytomas are the secondary cause of hypertension in 0.1% of hypertensive patients ***(Myckeljord, 2004).***

Pheochromocytomas secrete catecholamines episodically; between episodes, plasma levels or urinary

excretion of catecholamines may be normal. Thus, commonly utilized tests of plasma or urinary catecholamines and their urinary metabolites do not always reliably exclude or confirm the presence of a tumor ***(Pacak, 2000).***

A more recently developed biochemical test involving measurements of plasma free metanephrines, the O-methylated metabolites of catecholamines, offers advantages over other tests for diagnosis of pheochromocytoma ***(De jong et al., 2009).***

The aim of anesthetic management of pheochromocytoma is to control systemic effects of the tumor and to remove the tumor surgically, with providing optimal surgical conditions and suppress the responses to endotracheal intubation, surgical stimulation, tumor handling and devascularization ***(Petri et al., 2009).***

Laparoscopic adrenalectomy is recently considered a safe and efficient technique for removal of phaeochromocytoma in terms of intra and postoperative morbidity, with a low complication rate ***(Dawn et al., 2014).***

Monitoring of the arterial blood pressure done by an intra-arterial catheter is recommended due to the occurrence of significant hemodynamic changes during the laparoscopic approach. Also, monitoring of the volume status is essential

during surgery and postoperatively ***(James and Farling, 2010).***

Finally, experiences and excellent cooperation between surgeons, endochrinologists and anesthiologists are essential for successful prevention of perioperative complications associated with pheochromocytoma surgery ***(Luo et al., 2003).***

Aim of the Work

This work aims to discuss the pathophysiology and the anesthetic management for laparoscopic resection of pheochromocytoma.

Anatomy and Physiology of Adrenal Gland

I. Anatomy of the adrenal gland:

The suprarenal glands, also known as adrenal glands, belong to the endocrine system. They are a pair of triangular-shaped glands, each about 2 inches long and 1 inch wide, that sit on top of the kidneys. The suprarenal glands are responsible for the release of hormones that regulate metabolism, immune system function, and the salt-water balance in the bloodstream; they also aid in the body's response to stress ***(Farling, 2001).***

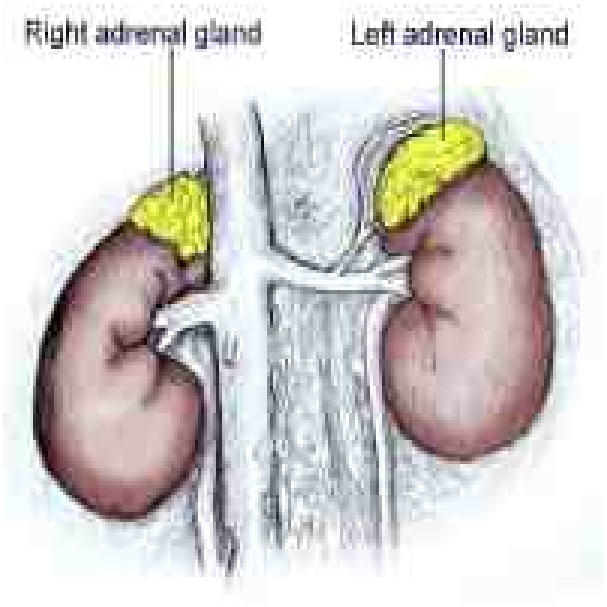

Fig. (1): Anatomy of adrenal gland ***(Farling, 2001)***

Each suprarenal gland is composed of 2 distinct tissues: the suprarenal cortex and the suprarenal medulla. The suprarenal cortex serves as the outer layer of the suprarenal

gland, and the suprarenal medulla serves as the inner layer. These 2 major regions are encapsulated by connective tissue known as the capsule ***(Vrezas et al., 2008).***

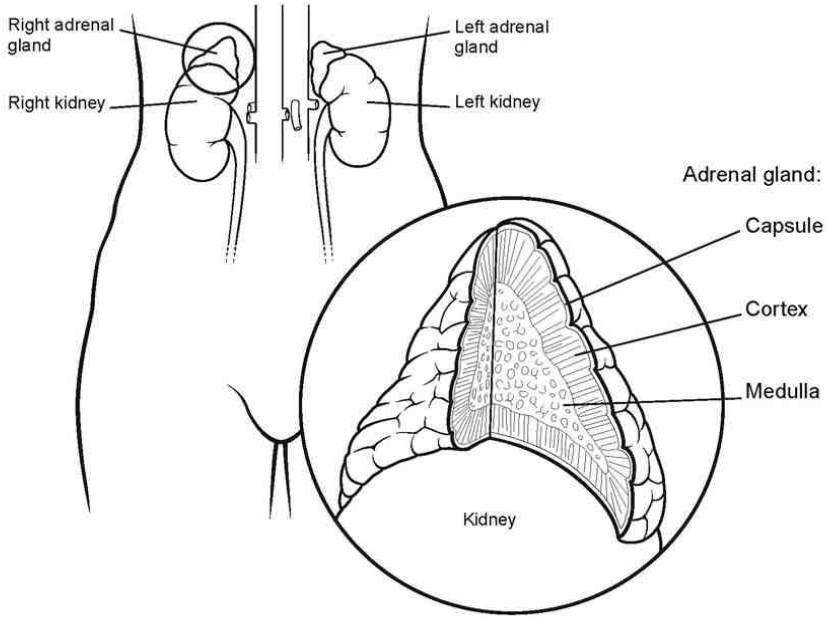

Fig. (2): Adrenal gland anterior view ***(Vrezas et al., 2008)***

1. Suprarenal cortex:

The suprarenal cortex is the largest part of the gland and is composed of 3 zones: the zona glomerulosa (outer zone), the zona fasciculata (middle zone), and the zona reticularis (inner zone). The zona glomerulosa is responsible for the production of mineralocorticoids, mainly aldosterone, which regulates blood pressure and electrolyte balance ***(Vrezas et al., 2008).***

The zona fasciculata, is responsible for the production of glucocorticoids, predominantly cortisol, which increases blood sugar levels via gluconeogenesis, suppresses the immune system, and aids in metabolism. This zone secretes cortisol both at a basal level and as a response to the release of adrenocorticotropic hormone (ACTH) from the pituitary gland ***(Vrezas et al., 2008).***

The zona reticularis produces gonadocorticoids and is responsible for administering these hormones to the reproductive regions of the body. Most of the hormones released by this layer are androgens. The main androgen produced by this layer is dehydroepiandrosterone (DHEA), which is the most abundant hormone in the body and serves as the starting material for many other important hormones produced by the suprarenal gland, such as estrogen, progesterone, testosterone, and cortisol ***(Vrezas et al., 2008).***

2. Suprarenal medulla:

The suprarenal medulla is composed of special cells called chromaffin cells, which are organized in clusters around blood vessels. The cells in the suprarenal medulla produce epinephrine (also known as adrenaline) and norepinephrine. These 2 hormones prepare the body for the fight-or-flight response by increasing the heart rate, constricting blood