The Patient is a 49-Year-old woman with a history of recurrent headaches, diaphoresis, and severe hypertension. During a physical examination, she was found to have an exceptionally high blood pressure (SP) of 220/140 mm Hg with a heart rate (HR) of 108 beats per minute. The patient denied any other medical problems except occasional anxiety. Further studies were obtained to evaluate the etiology of her high SP and headaches.

Discussion Questions:

What are some common problems that should be included in a differential diagnosis for hypertension?

There are many reasons why blood pressure (BP) would become elevated during surgery. The following is a partial list of reasons:

. Essential hypertension. Unknown etiology
. Primary renal disease. Nephritis, renal artery stenosis, and renal infarction
. Endocrine. Adrenocortical hyperfunction, thyroid disease, pheochromocytoma, and acromegaly
. Hemodynamic alterations. Decreased peripheral vascular resistance and increased intravascular volume
. Sympathetic stimulation. Light anesthesia, hypoxia, and hypercarbia
. Neurogenic. Seizure activity, elevated intracranial pressure, and denervation of the carotid sinus
. Miscellaneous. Malignant hyperthermia, neuroleptic malignant syndrome, carcinoid syndrome and toxemia of pregnancy


What is a pheochromocytoma?

Pheochromocytomas are catecholamine-secreting tumors of chromaffin tissue. They are usually located in the adrenal medullae or sympathetic
paraganglia, but may be found anywhere chromaffin tissue exists. These locations extend from the base of the skull to the anus. Although most pheochromocytomas are found in the medulla portion of the adrenal gland, 10% of these tumors are located elsewhere. Pheochromocytomas are entities that only account for 0.1% of all cases of hypertension. They occur in only 0.005% to 0.1% of people. When unsuspected or improperly managed during surgery, the physiologic effects of the released catecholamines can be profound.

The word pheochromocytoma is derived from the Greek words for dusky, phaios, and color, chroma. In 1912, Pick noted that these tumors stained a deep rust color when treated with chromium salts.


**In whom do we find pheochromocytoma?**

Pheochromocytomas occur in both sexes with peak incidence in the third to fifth decades of life. Approximately 5% of cases of pheochromocytomas are inherited as an autosomal dominant trait either alone or as part of the neoplastic syndrome, multiple endocrine adenomatosis (MEA).


**What is the incidence of pheochromocytoma?**
It is estimated that one to eight cases of pheochromocytoma occur per million persons annually. It seems that the incidence increases with advancing age. It also appears that there is a genetic predisposition with 10% to 20% of diagnosed patients with the disease having had a family history.


**How do you pharmacologically prepare the patient with a pheochromocytoma for surgery?**

The major goal is to partially block the responses to catecholamines and to avoid the pressor effects of the catecholamines. Although surgery remains the only definitive therapy, the above goals must be obtained as soon as the diagnosis is made by using pharmacologic methods. Administration of α-adrenergic blockers has been the cornerstone of management. The most commonly used agents have been phenoxybenzamine (POB) (Dibenzyline 10 to 20 mg, three to four times per day orally), prazosin (2 to 5 mg two times per day orally) and phentolamine as a constant infusion.

Phenoxybenzamine has been most widely used because of its relatively long duration of action and ease of administration. It irreversibly alkylates α-adrenergic receptors on vascular smooth muscle, thereby making them nonfunctional. It may cause postural hypotension and reflex tachycardia. These may be avoided with the careful administration of fluid volume as well as β-blockers. Be sure not to start β-blockade until the α-blockers have been started, otherwise congestive heart failure may be precipitated. Many feel that β-blockers should only be used when tachycardia or arrhythmias exist.

Prazosin has been used but does not seem to adequately prevent perioperative hypertensive episodes. Prazosin as well as magnesium sulfate (MnS04), β-blockers, angiotensin-converting enzyme (ACE) inhibitors and calcium channel blockers have been used in combination with POB to attain hemodynamic stability.

α-Methyl-paratyrosine inhibits tyrosine hydroxylase. It may be given orally, gradually increasing the dose from 0.5 g per day to 4 g per day. This may
decrease the catecholamine synthesis by 40% to 80%. It is very effective, but may cause diaIThea, sedative fatigue, anxiety, or agitated depression or tumors.

A study from the Cleveland Clinics suggests that preoperative use of a-blocking agents may not necessarily decrease the incidence of intraoperative hypertension or tachycardia. In fact, patients who did not receive preoperative POB had a few advantages. Eighty percent of these patients did not require vasopressors in the postanesthesia care unit (PACU), although the rest did so for a very short period of time. Similarly, 79% of patients received no vasodilators in the PACU. There was no difference in intensive care unit (ICU) length of stay between those patients who received preoperative POB/prazosin versus those who did not. It is possible that advances in anesthetic and monitoring techniques as well as the availability of fast-acting drugs capable of cOITecting sudden changes in hemodynamics has eliminated the need to use preoperative POB or prazosin in the preoperative period for those patients who are about to undergo surgery for a pheochromocytoma resection.


Connery LE, Coursin DB. Assessment and therapy of selected endocrine disorders.


Describe acceptable options for administering anesthesia to this patient.

Either general anesthesia, regional anesthesia, or a combination of the two are considered acceptable. For all techniques, it is important to avoid wide swings in blood pressure (BP).
For general anesthesia, induction with thiopental has been most commonly used, but induction with propofol has recently been reported to be a safe technique. One can lessen the response to intubation by administering 1.5 /Lg per kg lidocaine intravenously 2 minutes before laryngoscopy. Other measures to attenuate hemodynamic responses to intubation are described in Chapter 12, sections C.5. and C.6. General anesthesia has been maintained with most of the inhalation agents, but most commonly with isoflurane. Clinicians also seem to like the concomitant use of narcotics with the inhalation agent. Some authors advocate the avoidance of halothane because of its ability to increase the incidence of arrhythmias. Recently, the safety of desflurane was demonstrated. It was effective at controlling hypertensive surges in well-prepared patients, although it is known to cause sympathetic stimulation.


Whalley DG, Berrigan MJ. Anesthesia for radical prostatectomy, cystectomy, nephrectomy, pheochromocytoma, and laparoscopic procedures.


If a pheochromocytoma is found complicating pregnancy, does magnesium sulfate (MgSO4) have a role in managing the hypertension?

Reports indicate that MgSO4 can be used in conjunction with several potent inhalation anesthetics to control blood pressure (BP). Hypomagnesemia may be present in the pregnant patient and should be corrected preoperatively. Where an adequate level of magnesium can be achieved, its use may be ideal as an adjunct to anesthetic management because it has been shown that the use of magnesium to control BP is not deleterious to the fetus.


What is the significance of postoperative hypotension? How is it treated?

Postoperative hypotension is often seen after the excision of the tumor. This may be due to hypovolemia and/or persistent fatigue of the vasoconstrictor mechanism. Once the excess catecholamines are diminished after the removal of the tumor, the response by the vascular bed to maintain pressure may be sluggish. Hypotension is rarely seen in patients who have been adequately volume-expanded and a-blocked preoperatively. If it does occur, it should be treated with volume administration and, if needed, norepinephrine. Be cognizant of the fact that persistent hypotension may be secondary to bleeding.


Tan SG, Koay CK, Chan ST. The use of vasopressin to treat catecholamine-resistant hypotension after oochromocytoma removal.