The phenomenon of hypertension
Part II: Anesthetic considerations
for the hypertensive patient

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In part II of this two part article, the author describes the anesthetic implications of the hypertensive patient in general as well as techniques and approaches in particular. The author also describes approaches in the operating room as well as in the recovery room.

Part I of this article, published in the April, 1985 issue of the AANA Journal, dealt with the major classifications of hypertension as well as the relative incidences, etiologies and treatments for each type.

The hypertensive patient presents the anesthetist with a myriad of problems: drug therapy and anesthetic interactions, impaired and exaggerated response to stimulus and extensive organ damage due to the disease. These patients can ill afford major alterations in their volemic and blood flow status, yet these very conditions are likely to occur in surgery. Almost all hypertensive patients are on a battery of drugs to control their blood pressure. Most of these drugs can have the effect of augmentation or suppression of the anesthetic agents currently in use. Drugs most frequently encountered include alpha blocking agents, beta-blocking agents, digitalis, diuretics and peripheral vasodilators.

Beta blockade has serious implications for the anesthetist. It may prevent an adequate compensatory response to a rapid change in blood volume or peripheral vascular resistance such as in exsanguination and/or frank hypotension. These drugs are important in that they lower myocardial consumption of oxygen, and their abrupt discontinuance could result in myocardial ischemia if the heart is stressed. They should be continued up to and through surgery. Intraoperative use of beta blockers is usually of a short-term nature to prevent or offset tachycardia and ischemia in the patient with myocardial damage who is exposed to surgical trauma and stress. Beta blockers are often used in the patient with pheochromocytoma or severe renal artery stenosis to decrease tachycardia and therefore, myocardial oxygen consumption. They can also be used to treat the reflex tachycardia seen with other antihypertensive agents like the alpha blocking agents. Beta blockade can cause excessive bradycardia as well as bronchospasm. This bronchospasm is amenable to treatment with salbutamol or aminophylline. Treatment can range from administration of a beta receptor agonist like isoproterenol Isuprel® to insertion of a pacemaker for excessive bradycardia. Either way, the anesthetist must be cognizant of the delicate balance between myocardial oxygen supply and demand in these patients.

Many hypertensive patients are taking diuretics. These drugs cause sodium and water loss with resultant extracellular volume depletion. There is often hypokalemia due to potassium loss with attendant arrhythmias unless potassium is given exogenously. The patient may also be alka-
otic through the loss of hydrogen ions in the urine, and there may be decreased sympathetic activity in the peripheral blood vessels. Volemic and electrolyte status should be ascertained preoperatively, and the anesthetist should be suspicious if arrhythmias occur.

Alpha blocking agents can and do interact with anesthetics. They inhibit norepinephrine release and may also interfere with renal function. This not only interferes with the patient's response to stimuli, but may decrease the excretion of metabolites. Methyldopa (Aldomet®) decreases peripheral vascular resistance, and, because of its "false transmitter" activity, renders the patient less able to respond to bouts of hypotension in the operating room. Hypotension in patients who are taking methyldopa is better treated with direct-acting alpha agonists, as indirect agonists may only elicit the weakened response characteristic of patients on methyldopa therapy. Methyldopa also may cause a hepatitis-like syndrome which has implications for metabolism and halothane anesthesia.

Clonidine is an alpha blocker that must be continued up to and through surgery due to its rebound hypertensive effects. This can pose a problem since it is only available in oral form. The patient on clonidine may need to be given this drug orally during the actual surgical procedure. The anesthetist should also have a rapidly acting peripheral vasodilator available should rebound hypertension occur. The patient on alpha blockers may not be able to respond appropriately to hypotension, and the anesthetist must be prepared to intervene.

Patients on peripheral vasodilators are at risk in that they are often very labile. They are blocked peripherally and require meticulous hemodynamic monitoring. Vasodilators increase venous capacitance while decreasing venous return. This, in turn, decreases end-diastolic volume and pressures in the heart. There is a resultant decrease in stroke volume and cardiac output. Drops in blood pressure are poorly tolerated and end organ damage is likely to occur if that drop is sustained.

Ganglionic blockers are rarely used currently. Trimethaphan (Arfonad®) and pentolinium are seen only occasionally; patients on these drugs are labile and require careful hemodynamic monitoring.

**Preoperative and perioperative management**

Preoperative evaluation of the hypertensive patient includes an interview with a thorough history, physical, pharmacological profile, lab data and appropriate preoperative medication orders. A history not only ascertains physiological state, but also the duration of the disease along with attendant problems such as smoking and obesity. Minimum preoperative lab studies include ECG, chest x-ray, serum electrolytes, complete blood count, blood sugar and, in the case of smokers, pulmonary function tests and arterial blood gases.

The monitoring of the hypertensive patient is, of course, based on the above parameters. Generally, ECG, blood pressure, esophageal stethoscope and temperature monitoring are the minimum standard. Oxygen analyzers, direct arterial monitoring of blood pressure, serial arterial blood gases and electrolytes are required for the larger cases. CVP and/or Swan-Ganz catheter insertion may be required for volume management and the calculation of cardiac output and systemic vascular resistance. The patient should also be monitored on a modified chest lead designed to show ST segment changes heralding myocardial ischemia.

All aims in monitoring the hypertensive patient are directed at assisting the anesthetist in maintaining the patient at his relative normal level. The goal, of course, is to reduce the morbidity and mortality associated in sustained rises and falls in the blood pressure of the normally hypertensive patient. The hypertensive patient functions optimally with a certain pressure range and his body and vascular system have adapted to this. Careful monitoring will allow the anesthetist to be aware of changes quite readily and to take appropriate and rapid intervention should changes occur. Although this full monitoring is not therapeutic in itself, it does buy time for the anesthetist and the patient should a disaster occur.

Induction techniques vary and are aimed at preservation of the patient's delicate cardiovascular balance. Nitrous oxide-oxygen and pancuronium are often used to avoid the circulatory depression seen with the standard thiopental induction and are quite effective in the patient with moderate cardiovascular disease. Hypertension is often seen following intubation; however, intubation may be poorly tolerated in patients with more severe hypertensive disease. A standard induction with ultra short-acting barbiturates and succinylcholine is also performed with success, but again, rises in blood pressure are often seen with laryngoscopy. In the patient with poor left ventricular function and coronary artery disease, the barbiturates may cause too much myocardial depression and can precipitate a disastrous hypotension.
High dose fentanyl 50-150 μg/kg, with 100% oxygen produces little or no cardiovascular depression, and is generally deemed quite safe for the hypertensive patient with coronary artery disease. The addition of nitrous oxide can produce too much myocardial depression, however, and should be avoided in those patients with significant myocardial disease. If the surgical case is a minor one and of short duration, this technique is perhaps not the best choice. This, of course, is up to the judgment of the individual practitioner.

Neurolept anesthesia with either a diazepam-fentanyl or droperidol-fentanyl combination pre-induction will serve to not only decrease anxiety but also often decreases the lability of the blood pressure by eliminating the anxiety and stress components. In the case of diazepam, large doses are needed and its use may be limited in the very ill patient who is already depressed and acidotic. The alpha blocking effect seen with the droperidol component in Innovar® can cause large drops in blood pressure, as these patients' intravascular volume is contracted due to long term vasoconstriction. Innovar® must be titrated in slowly with meticulous hemodynamic monitoring to prevent and perhaps treat hypotension.

Ketamine may also be used as an induction agent, but it may cause myocardial depression as well as increase cerebral metabolic requirements for oxygen due to increased cerebral and central nervous system activity. In summary, induction techniques are important because of their stress effect on the patient. What the anesthetist chooses is not so important as how expertly and smoothly the technique is employed. The practitioner should choose a technique that is safe for the patient as well as one that he/she does well.

Maintenance of anesthesia is generally an extension of the induction technique used. Narcotics and inhalation agents are both entirely adequate and their use is according to the discretion of the anesthetist. Muscle relaxants are also agents of choice. Tubocurarine may cause hypotension due to its dilating and histamine-releasing properties. Pancuronium's weak vagolytic effect can cause increases in heart rate with concomitant increase in myocardial oxygen demand. There can be an increase in cardiac output and blood pressure as well. All relaxants should be titrated in small doses with the help of a nerve stimulator to ascertain block strength. Maintenance is aimed at not only providing the surgeon with an adequate operating environment, but also maintaining the patient at a relative physiological state appropriate for his disease. Again, it is not so much what one uses but how one uses it.

**Postoperative management**

The severity of the patient's vascular disease will determine the ease of emergence from anesthesia. Those patients with severe coronary artery disease or myocardial failure are generally not good candidates for reversal and extubation. This is a dilemma because postoperative hypertension is also a problem and may be exacerbated by the presence of an endotracheal tube in the unsedated patient. Those patients who are on beta blockers or who have a fixed heart rate not responsive to atropine are not good candidates. The potent muscarinic effects of most of the reversal agents will not be offset by atropine in these patients, and bradycardia may worsen with resultant hypotension. Careful titration of intraoperative muscle relaxants is, once again, the key. The nerve stimulator should be used to determine the extent of the blockade and efficacy of reversal. If the patient's neuromuscular blockade status is unknown and/or his cardiovascular status precludes reversal, extubation should not be attempted, and the patient should be adequately sedated for his stay in the recovery room. Postoperative alpha blocking agents should also be readily available to treat acute rises in blood pressure as the patient emerges from anesthesia. Nitroprusside, nitroglycerin and hydralazine are all good choices for this acute situation. The hypertensive patient presents a challenge in that, on emergence, pain and fluid shifts can exacerbate hypertensive problems in a patient with little coping ability or reserve. Appropriate steps must be taken to intervene quickly and control these rapid changes in blood pressure.

Volume replacement in the hypertensive patient is often tricky. These patients are often chronically hypovolemic due to longstanding vascular constriction. Their circulation is maintained by increasing peripheral vascular resistance along with venous constriction if there is a drop in pressure. All available monitoring parameters should be watched closely and sudden falls or rises must be dealt with immediately. Volume and pressors should be used for hypotension and alpha blockers for rises in blood pressure. If the patient has any myocardial damage or failure, volume replacement may be risky. Pulmonary capillary wedge pressure should be monitored in those patients with congestive heart failure so that the delicate balance between hypovolemia and overload is maintained. Combine this volume vulnerability with the altered response to drugs and anesthetic agents, and
one can see why sometimes the anesthetist literally has a "tiger by the tail."

Lastly, mention should be made of the management of the hypertensive patient in the recovery room. Hypertension may be caused by any number of things; the type of surgical procedure as well as the underlying disease state may be the precipitator of a hypertensive crisis in the recovery room. Hypertension occurs postoperatively in approximately 60% of patients undergoing vascular surgery. Neurosurgical patients may have as much as a 10-15% incidence of postoperative hypertension. The etiologies of the hypertension may vary; pain and the stress response from anesthesia and surgery can cause rises in blood pressure.

Hypoventilation and hypercarbia may also cause bouts of hypertension. Hypercarbia will dilate smooth muscle and decrease peripheral vascular resistance. This decrease will stimulate the adrenal medulla to increase circulating catecholamine levels. Inadequate reversal or narcotic-induced respiratory depression can cause this gradual and often subtle hypoventilation.

Hypothermia and shivering in the recovery room not only increase blood pressure but also increase metabolic requirements for oxygen, thereby further jeopardizing the patient with severe coronary artery disease. Volume overload, which can easily occur in these patients, can also be a big precipitant of hypertension. In those patients with left ventricular failure, pulmonary edema is a real possibility.

Aging and its accompanying atherosclerotic vessel changes may aggravate a pre-existing mild hypertension in the post-operative period. One should be prepared for the elderly patient with low to moderate elevations in blood pressure in their preoperative history. Acute exacerbations can and often do occur after the stress of an operative procedure.

All these situations must be dealt with quickly to return these patients to their relative normal state before damage occurs. The most dangerous times, of course, are during patient transport to, and reception into, the recovery room. At this time the anesthetist should monitor the patient's blood pressure with either a portable monitor or a hand on the pulse to ascertain changes. Alpha blockers should be available and the recovery room nurses should be made aware of the patient's history. The anesthetist should set priorities for the reception of these patients in the recovery room. The patient's blood pressure should be immediately monitored so that appropriate intervention may be taken.

Summary

The management of the patient with hypertension has three major aims. The first is the selection of anesthetic agents and techniques that cause minimal cardiovascular disturbance. These agents and techniques must decrease the stress from surgery without compromising the patient. Second, emphasis must be placed on the role of ischemic heart disease and hypertension, as well as end organ damage in the event of sustained hypertension. Lastly, the anesthetist should have an awareness of the pharmacological effects and interactions of various antihypertensives with anesthetic agents in use. The anesthetist who is knowledgeable in these three areas will be better able to choose the best and safest anesthetic management for his patient.

Overall, the anesthetist is responsible for the well-being of these very sick and too often labile patients. Anesthesia serves to protect these individuals from the trauma and stress of surgery as well as to provide the surgeon with an optimum field for operating. Armed with knowledge and a careful approach, the anesthetist will be able to provide a safe, physiologically appropriate anesthetic for these very ill patients.

REFERENCES


AUTHOR

Lynn Ralph, CRNA, BS, received her undergraduate degree in nursing from St. John College of Cleveland. She also attended John Carroll University in Cleveland for three years, taking premedical courses, and received her anesthesia education at the Cleveland Clinic Foundation School for Nurse Anesthesia. She is currently assistant director for the Cleveland Clinic School of Nurse Anesthesia and has a special interest in anesthesia for major urological procedures.