Anesthesia and Hypertension: Cardiovascular Responses of treated and untreated hypertensive patients

Manuel L Fontes, MD
Associate Professor of Anesthesiology and Critical Care
Weill Medical College of Cornell University

Perhaps nowhere is the assessment, characterization, and management of hypertension more important than in the setting of cardiac or major vascular surgery- a period marked by an acute and stressful physiologic perturbation involving excessive release of catecholamine, reperfusion injury, humoral and cellular inflammatory response, and platelet activation which can compromise microvascular blood flow. A number of studies have found an association between preexisting hypertension and increased risk of perioperative complications including stroke, myocardial infarction, congestive heart failure, bleeding, and renal dysfunction. In contradiction, no absolute threshold of preoperative systolic or diastolic blood pressure exists for delaying or canceling surgery and, overwhelmingly, available preoperative risk assessment guidelines do not consider preoperative hypertension as a risk factor for surgical morbidity. Only recently have we addressed characterization of hypertension by specific subtypes and assessed the risk of postoperative complications relative to each subtype of hypertension. Nevertheless, failure to recognize the important difference amongst the various types of HTN (previously and currently) explain the inconsistent results relating preexisting blood pressure to perioperative vascular complications and further perpetuate an antiquated practice.

Recommendation regarding management of blood pressure perioperatively is also lacking, and, when prescribed, it is often arbitrary. Similarly, no recommendations exist
for management of diastolic blood pressure. It is concerning that currently available vasoactive drugs are not selective in lowering or raising of SBP or DBP without affecting the other component similarly. As such, while attempting to treat systolic hypertension in susceptible individuals, DBP may be excessively diminished resulting in ischemic injury.

Undermining the broad-based reliance on SBP and DBP are a number of studies in humans over the past several decades that clearly show that both morbidity and mortality do not always linearly correlate with rises in blood pressure. In individuals with demonstrable coronary disease, namely, those with previous infarcts, coronary mortality was significantly related to diastolic pressure in a U shape configuration; whereby, mortality was highest at both the lower and higher levels of DBP. Clearly, both the systolic and diastolic components of blood pressure are important for assessing and monitoring circulatory function; however, it should be recognize that blood pressure is an extremely complex physiologic parameter.

Yet, a third component of blood pressure—pulse pressure—has been recently shown to be even more powerful than SBP or DBP in predicting cardiac, cerebral, and renal ischemic events. Given that the physiologic underpinning which has evolved over the past decade for consideration of alternative measurement of blood pressure (its monitoring and prognosis) applies justifiably to surgical patients, we pursued the question of characterization of preexisting hypertension subtypes and their association with ischemic outcomes in a high risk surgical population undergoing an acute and severe physiologic stress. We reported that pulse pressure hypertension but not systolic nor
diastolic hypertension was associated with cerebral, cardiac, renal and overall mortality after CABG surgery.

Our findings indeed challenge conventional characterization of blood pressure assessment. Nowhere, to our knowledge, has increase in pulse pressure been shown to add to morbidity and mortality in the setting of surgery. Mortality from all causes and from cardiac etiology occurred nearly 200% more often in patients with elevated pulse pressure; in fact, the associated ischemic burden was global- tripling the risk of stroke and doubling the risk of renal events. These findings are consistent with reports from longitudinal studies in ambulatory subjects identifying pulse pressure as a better predictor of both coronary heart disease (CHD) and stroke than SBP or DBP. In the middle-aged and in the elderly, CHD was shown to increase with lower DBP at any level of SBP ≥ 120 mmHg. The death rate has also been shown to be highest in hypertensive individuals with SBP of 160 mmHg or more and DBP of less than 70 mmHg – a pulse pressure value > 90 mmHg. While a significant number of patients with ISH also have PPH—both reflecting non-compliant arterial conduits —rises in pulse pressure at fixed SBP are associated with a much greater risk of coronary ischemic event than increments of SBP at fixed pulse pressures. This may also explain the nonlinear relation between incremental rises in SBP and stroke rates. Nearly half of our study participants with PPH also had ISH. According to multivariate analysis, pulse pressure was the only component of blood pressure to prognosticate stroke as well as death and renal ischemic events.

The cardiovascular, cerebrovascular, and renovascular pathophysiology involved in PPH are unclear. Most often, a decrease in perfusion pressured is implicated.
Presumably, critical mismatch between oxygen delivery and oxygen need can occur in the setting of a reduced DBP with an elevated SBP. In our study, the group with PPH presented with a significantly higher SBP and, by design, a large difference in pulse pressure (91 ± 9 mmHg vs. 56 ± 12 mmHg) as compared to the group without PPH.

If other characterizations of blood pressure are more accurate, than the entire cornerstone of perioperative hemodynamic monitoring may be dramatically affected. This question of alternative characterization is especially important for surgical patients having major vascular surgery, in whom the pathogenesis of pulse pressure seems to be markedly accelerated. While the exact mechanism of injury is unclear, the stress of surgery appears to accelerate the pathogenesis of PPH, causing fatal and nonfatal complications, which in the ambulatory setting, often take years to decades to manifest. A call for newer characterization of hypertension according to subtypes has long been proposed but has yet to become incorporated in medical training or practice. Its serious impact on surgical patients substantiates such movement and hopefully will serve as a catalyst for a paradigm shift in blood pressure monitoring and treatment.
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