Perioperative Blood Pressure Control and Management

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KEYWORDS

• Blood pressure • Anesthetics • Positive inotropes • Sympathomimetics
• Hypotension

KEY POINTS

- Blood pressure monitoring is essential in perioperative patients, and recognition and appropriate therapy are critical for successful outcomes in these patients.
- There are numerous mechanisms that a patient will use to try to maintain normal blood pressure and perfusion, but many of the anesthetic agents that are used may inhibit their ability to regulate blood pressure.
- Hypotension during anesthesia can be caused by decreased cardiac output (secondary to decreased heart rate, stroke volume, or both) or decreased systemic vascular resistance, or a combination of both.
- Treatment of hypotension should be directed by identification of the underlying cause of the hypotension.

Blood pressure is a vital parameter to monitor in the perioperative period. Major fluctuations with either hypotension or less commonly hypertension can have serious consequences for the patient. How susceptible the patient is to damage from abnormal blood pressure will be variable depending on if there are any underlying illnesses. As an example, a patient with renal disease will have lost renal autoregulation, a mechanism by which the body maintains normal glomerular filtration rate and renal blood flow over a wide range of blood pressures.[1] Without autoregulation, the kidney will lose blood flow and glomerular filtration rate at blood pressures at which healthy animals would have no deleterious effects. As such, it is vital that each patient be assessed for potential risk factors for blood pressure dysregulation.

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To manage blood pressure, it is necessary to measure blood pressure accurately; unfortunately, this is very challenging. Generally, either direct or indirect methods are used. Direct blood pressures have been considered the gold standard for measurement and are often used in very critical patients. Data have shown however that even direct blood pressures can be discordant in cats[2] and dogs.[3] The discrepancy is great enough that if the criteria for blood pressure device validation were applied in comparing carotid artery blood pressure values to dorsal pedal or femoral artery pressures in dogs, none of the systolic values obtained would be acceptable.[4] Indirect monitors have also been considered inaccurate, although at times this may be because the direct methods used were not reliable or appropriately carried out. There are certainly significant issues with managing blood pressure when the numbers obtained by any method have to be questioned. Nonetheless, blood pressure monitoring is vital, although at times it is important to realize that trends are the predominant thing being monitored because absolute numbers often are elusive. It is also important that blood pressure monitoring in the perioperative period be consistent. Given the variability of the numbers generated by various methodologies, it is advisable to use the same method in a patient being monitored to be able to more readily identify trends. It is also advisable that whatever technique is used is a technique the operator is experienced with to be able to troubleshoot any problems that occur.

BLOOD PRESSURE CONTROL

Arterial blood pressure is controlled by many mechanisms, all of which interact to provide optimal tissue perfusion under different circumstances. These mechanisms can be classified according to the time period in which they respond to a situation and act to perform a correction.

Ultra-Short-Acting Blood Pressure Control Systems

Autoregulation systems can adapt to changes produced by anesthetic agents, although these mechanisms may still be affected by certain drugs. Metabolic nitric oxide results in vasodilation increasing blood flow to the tissue-enhancing removal of waste products and increasing delivery of oxygen and nutrients. A continual supply of nitric oxide is required because it has a very short lifespan (nanoseconds).

Individual organs, such as the brain and kidney, can use a similar and more refined system of organ autoregulation, which ensures a steady blood flow to the whole tissue during periods of hypotension. Other organ systems that do not have mechanisms of autoregulation, such as the gastrointestinal tract, rapidly become debilitated during prolonged periods of hypotension.

Short-Acting Blood Pressure Control Systems

The control of blood pressure provided by the autonomic nervous system (ANS) is most relevant to the period of anesthesia. The response time for the ANS to accommodate tissue perfusion requirements is on the order of seconds to minutes, and many changes produced by the ANS can be observed with the aid of monitoring equipment and techniques. The physiology and management of the ANS in critically ill animals have been extensively reviewed elsewhere.[5]

Baroreceptors within the aortic arch and the carotid sinus detect the stretch produced by pressure from blood flow. An increasing degree of stretch increases the neural input to the vasomotor center via the glossopharyngeal nerve (carotid sinus baroreceptors) and vagus nerve (aortic arch baroreceptors). The efferent arm of this