ANESTHESIA FOR THE RENAL PATIENT

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RENA L PHYSIOLOGY:

The prime role of the kidney is to precisely regulate fluid and electrolyte homeostasis. While accomplishing its prime task the kidney also is one of the most important organs dedicated to eliminating water soluble metabolites, controlling vascular tone and regulating hematopoiesis. In order to correctly perform these vital functions, the kidney requires 20% of the cardiac output and has the capability to autoregulate its blood flow as long as the mean arterial blood pressure of 50 to 150 mm Hg\(^1\). The renal cortex receives most of the renal blood flow, in contrast to the more metabolically active renal medulla. During hypotensive episodes the kidney has the ability to preferentially distribute blood flow to the medulla and the inner cortex this allows for an early preservation of glomerular filtration rate (GFR). However, if sustained hypotension continues the kidney loses the ability to maintain GFR. The kidneys have the ability to sustain severe insults and still maintain their physiologic role. However, multiple or prolonged episodes of hypovolemia or hypoxemia will cause enough damage that results in clinically evident decrease in function. Hypotension and ischemia reperfusion injury are the most common causes of renal insults during the perioperative period in the dog and the cat.

ASSESSMENT OF RENAL FUNCTION:

Measuring directly GFR can be costly and impractical and for these reasons it is rarely done in small animal patients. Other markers of renal function are monitored instead of GFR. Serum creatinine is the most commonly utilized marker for renal function. However, it is very insensitive and takes time to increase. For these reasons creatinine is more useful to assess renal function rather than renal injury. Urine output is not a reliable measure of renal function during the perioperative period. This is because many factors and drugs that happen in the perioperative period influence this parameter. Opioids, inhalants and vasodilation cause low urine output with a easily reversible pre-renal azotemia or interference with the anti-diuretic hormone.

RENA L PROTECTION DURING THE PERIOPERATIVE PERIOD:

Fluids are essential in maintaining renal blood flow and GFR. A good hydration status is essential for the prevention of renal injury and maintaining optimal renal function during anesthesia. Intra-venous fluids have also been proven to be effective in the prevention of contrast induced kidney injury, especially in patients with already some degree of renal impairment. Dopamine has been found to have no therapeutic or protective effect on acute kidney injury. However, dopamine will have beneficial effects in treating hypotension and decreased cardiac output during anesthesia. This will preserve renal perfusion and function in face of vasodilation and hypotension. Careful use of loop diuretics and mannitol during anesthesia of renal patients, diuretics increase renal blood flow but if used without adequate fluid therapy they could also exacerbate hypotension\(^2\).

ANESTHESIA AND RENAL FUNCTION:

No conclusive clinical studies exist that clearly identify a superior anesthe sia technique for renal patients.
Maintaining adequate hydration and normovolemia is key to maintain adequate renal perfusion. Inhalational anesthetics decrease GFR by causing vasodilation and decreasing myocardial contractility, ultimately causing hypotension. Positive pressure ventilation used to maintain adequate ventilation under anesthesia decreases venous return to the heart and consequently decreases cardiac output. Care must be taken in this patient population to use minimum concentrations of volatile anesthetics and minimizing the peak airway pressure during mechanical ventilation. The use of injectable anesthetic drugs and loco-regional anesthesia in conjunction with inhalational anesthetics will improve cardiovascular function.

Animals with renal insufficiency undergoing general anesthesia are at higher risk for morbidity and mortality. Most commonly patients with renal insufficiency have altered acid base status, electrolyte imbalances and poor hydration status. It is of pivotal importance to correct these, when possible, before general anesthesia. Close monitoring of arterial blood pressure is key to detect and treat hypotension. Invasive blood pressure monitoring is sometimes required for long invasive procedures in these particular patients.

Anemia is a frequent finding in patients with chronic renal insufficiency and to make things even worse these patients are at higher risk of bleeding due to platelet dysfunction and decreased circulating von Willebrand factor. Desmopressin can be administered prior to surgery to improve coagulation in patients with coagulation disorders related to uremia. Blood products should be considered if the anemia is severe.

REFERENCES:

