Anesthesia for Patients with Concomitant Cardiac and Renal Dysfunction

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KEYWORDS

• Renal failure • Cardiovascular disease • Anesthesia • Anesthetic goals • Surgery

KEY POINTS

- Renal disease and cardiovascular disease (CVD) are commonly encountered in the same patient.
- The dynamic interactions between renal disease and CVD have an impact on perioperative management.
- Renal failure is an independent risk factor for CVD and the link between the two disease states remains to be fully elucidated.

INTRODUCTION

Cardiovascular and renal disease are important, interrelated causes of perioperative morbidity and mortality. In the perioperative setting, renal dysfunction is an important predictor of major adverse cardiac events as evidenced by its inclusion as 1 of only 6 risk factors used to determine perioperative cardiac risk.[1] In the United States, the prevalence of CVD in patients with chronic kidney disease (CKD) is 9 times higher than it is in the general population[2] and CVD contributes to more than half of deaths among patients with renal failure.[3] Because it is increasingly common to encounter patients perioperatively with varying degrees of renal and cardiovascular dysfunction, a comprehensive understanding of the complexities emerging from simultaneous impairment of these organ systems is needed. Anesthetic goals in these circumstances setting may be competing or concordant depending on the nature and degree of cardiovascular and renal impairment.

The pathophysiologic basis for the relationship between CKD and CVD has not been clearly elucidated. Traditional CVD risk factors (ie, age, male gender, hypertension, smoking, and so forth) do not explain the entirety of the increased incidence of CVD in CKD patients. Conversely, although CKD-related risk factors, such as abnormal

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Anesthesiology Clin 34 (2016) 697–710
http://dx.doi.org/10.1016/j.anclin.2016.06.006
anesthesiology.theclinics.com

calcium and phosphorus homeostasis, and hypertension, are associated with cardiovascular pathology, reversal of these of risk factors does not decrease CVD related mortality. Taken together, these data suggest a missing link between CKD and CVD. Although several hypotheses have been proposed, it remains an area of ongoing research.[4,5]

ANESTHETIC GOALS IN PATIENTS WITH KIDNEY DISEASE

The renal system plays a vital role in the maintenance of homeostasis and is primarily responsible for maintenance of fluid and electrolyte balance and excretion of metabolic waste products. It also plays an important role in regulation of vascular tone, hematopoiesis, and bone metabolism. Both renal dysfunction and the therapies used to manage it have wide-ranging physiologic consequences relevant to perioperative care (**Box 1**).

Metabolic acidosis is common in patients with renal failure and is primarily due to impaired renal excretion of organic acids. The early stage of acute kidney injury is characterized by a nonanion gap acidosis secondary to impaired generation of ammonia. As the initiation phase progresses to the maintenance phase, an anion gap acidosis is observed secondary to impaired excretion of fixed acids. In a spontaneously breathing patient with impaired renal function and consequent metabolic acidosis, respiratory function may be inadequate to normalize for the pH, and patients should be carefully monitored for signs of progression to respiratory failure.

Various electrolyte abnormalities can be expected in the setting of renal failure, including elevated potassium, magnesium, and phosphate, and decreased calcium and sodium. Because of impaired potassium handling, special consideration must be paid to blood product administration. In patients with elevated baseline potassium levels, the increase in serum potassium concentration associated with rapid transfusion of packed red blood cells is less well tolerated. Electrolyte abnormalities contribute to the high arrhythmia burden in patients with renal dysfunction. The greatest contributor to mortality in end-stage renal disease (ESRD) is sudden cardiac death, accounting for 25% of all-cause mortality in this population.[6] Arrhythmias in ESRD patients are associated with poor prognosis. In diabetic patients with ESRD, the absence of sinus rhythm is associated with a 75% increase in cardiac death or myocardial infarction (MI).[7] Therefore, close monitoring with active prevention and treatment of arrhythmias becomes an important management priority.

Box 1
Systems review in patients with renal failure

- Electrolyte abnormalities
- Acid-base abnormalities
- Anemia
- Hypotension/blood pressure lability
- Impaired drug clearance
- Volume status
- Effects of renal replacement therapy
- Uremia
- Platelet dysfunction
- Difficult intravenous access