

## The important relationship between the kidney and the heart

Thomas Kahan

*Karolinska Institutet, Department of Clinical Sciences, Danderyd Hospital, Division of Cardiovascular Medicine, Stockholm, Sweden; and Department of Cardiology, Danderyd University Hospital Corporation, Stockholm, Sweden*

Opinions diverge about hypertension being a disease belonging to nephrology or cardiology, and I believe the answers are as many as the number of persons you ask. Maybe hypertension is not a single disease but a hemodynamic syndrome, and should be better considered a risk factor for cardiovascular (and other) events<sup>1</sup>. More important, however, is the strong interdependent relationship between the heart and the kidney. In several disorders involving kidneys and the heart, acute or chronic dysfunction in one organ may affect the other organ, which is named the cardiorenal syndrome. A more precise definition of the cardiorenal syndrome than the simplistic view of renal dysfunction secondary to heart disease was advocated more than a decade ago, suggesting five subtypes<sup>2</sup>. A recent very comprehensive review of the cardiorenal syndrome by McCulloch, Rangaswami, and collaborators<sup>3</sup> now adds to our understanding and provides future directions in cardiorenal medicine.

Type 1 cardiorenal syndrome is an acute syndrome of heart failure (e.g. an acute coronary syndrome or acute heart failure) resulting in acute kidney injury, and type 2 is a chronic syndrome of chronic heart failure resulting in chronic kidney disease. Type 3 is an acute renocardiac syndrome with acute kidney injury (e.g. volume overload, inflammatory surge, or uraemia with metabolic disturbances) resulting in acute heart failure, and type 4 is a chronic renocardiac syndrome with chronic kidney disease resulting in chronic heart failure (by e.g. left ventricular hypertrophy or cardiomyopathy associated with chronic kidney disease). Finally, secondary cardiorenal syndrome (type 5) is a systematic condition (e.g. amyloidosis, sepsis, or cirrhosis) resulting in both heart failure and renal failure. These types represent different hemodynamic conditions where the failing heart affects the kidneys or vice versa, and different characteristic patterns of activated neurohormonal and inflammatory pathways.

A diagnosis of cardiorenal syndrome requires signs and symptoms, as well as evidence structural or functional abnormalities in the heart and the kidneys. This review<sup>3</sup> provides a comprehensive overview of available cardiac biomarkers (myocyte death, wall tension, and myocardial fibrosis) and renal biomarkers (glomerular filtration and integrity, and tubular injury), and imaging modalities. Of note, these available common biomarkers also offer prognostic information in acute and chronic cardiorenal syndromes. Specific drug treatment directed to the underlying mechanisms, including diuretics, neurohormonal modulation, vasodilators, and inotropic therapy, with current evidence from clinical trials is presented. Finally, cardiac device based therapy and the treatment of heart failure in kidney transplant patients is reviewed.

Patients with cardiac and renal disease combined have an unacceptable high risk of symptoms, hospitalizations, and fatality rate. A multidisciplinary approach including cardiologists and nephrologists is obviously important in the management of these patients. The target for management of patients a cardiorenal syndrome should be reduction of major cardiovascular (including myocardial infarction, heart failure, and stroke) and renal (including acute kidney injury, progression of chronic kidney disease, renal replacement therapy) events, hospitalizations and death. An increased awareness and understanding of the cardiorenal syndrome is important to all of us.

Thomas Kahan - [thomas.kahan.sll.se](mailto:thomas.kahan.sll.se)

### References

1. Folkow B. Hypertension 1990;16:89-101. doi: 10.1161/01.HYP.16.1.89
2. Ronco C, Haapio M, House AA, *et al.* Cardiorenal Syndrome. J Am Coll Cardiol 2008;52:1527-1539. doi: 10.1016/j.jacc.2008.07.051.
3. Rangaswami J, Bhalla V, Blair JEA, *et al.* American Heart Association Council on the Kidney in Cardiovascular Disease and Council on Clinical Cardiology. Cardiorenal Syndrome: Classification, Pathophysiology, Diagnosis, and Treatment Strategies: A Scientific Statement From the American Heart Association. Circulation 2019;139:e840-e878. doi: 10.1161/CIR.0000000000000664.