New diagnostic tools for acute kidney injury 
in critically ill patients

S Heemskerk, P Pickkers

Department of Intensive Care Medicine, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands

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Acute kidney injury (AKI) in the intensive care unit (ICU) is increasingly common and associated with substantial morbidity and mortality [1,2]. AKI occurs in approximately 7% of all hospitalized patients [3] and in up to 36% to 67% of critically ill patients depending on the definition used and the patient population studied (e.g., sepsis, trauma or cardiothoracic surgery) [4,5]. While AKI requiring renal replacement therapy (RRT) in the ICU is a well-recognized independent risk factor for in-hospital mortality, it is important to realize that even small changes in serum creatinine are associated with increased mortality [6].

The cause of AKI in the ICU is likely to be multifactorial and frequently develops from a combination of hypovolaemia, sepsis, nephrotoxic medication, and haemodynamic perturbations. Despite decades of clinical trials investigating the therapeutic potential of pharmacological interventions in AKI, current treatment options are primarily limited to RRT and avoidance of further renal damage.

For the diagnosis of AKI and determination of its etiology, clinical history, physical examination, the serum creatinine, renal ultrasound, fractional excretion of sodium and urea, and urine microscopy remain the cornerstones of the diagnostic tools available to the clinician in the ICU. These ‘conventional’ tools are useful and readily available, but have their drawbacks. For example, the use of serum creatinine to estimate the glomerular filtration rate has limited value in critically ill patients due to the lack of steady-state conditions [4]. The gold standard, histological diagnosis of AKI is rarely obtained in critically ill patients. The major reasons for this include the risk of complications of renal biopsy in critically ill patients with, for example, coagulatory disturbances and in general the lack of therapeutic consequences. However, this is not always the case. In this issue of NJCC an interesting case report on transjugular renal biopsy is published [15]. Javaid et al. describe a patient with persistently increased creatinine values that could be due to vasculitis or a post- infectious immune-complex glomerulonephritis. To establish a definitive diagnosis and guide further management, a transjugular renal biopsy (TJRB) was performed. In this patient the renal biopsy showed vasculitis and her renal function improved after immune suppressive treatment.

Although worldwide TJRB has been performed in thousands of patients with excellent tissue adequacy [7,8], studies in critically ill patients are scarce. In comparison with percutaneous or open biopsy, TJRB appears to be a relatively safe technique in the critically ill patient. Haemorrhage (renal haematoma and calyceal bleeding) is a significant complication both after percutaneous or TJRB, but this risk is possibly smaller in TJRB [9]. A small case series reported that in 9 patients who used oral anticoagulation and in whom percutaneous biopsy was contraindicated, bleeding complications occurred in 2 of them [10].

In the near future other new imaging techniques in nephrology may become available. A technique called Cine Phase-Contrast Magnetic Resonance Imaging (MRI) [11] appears to be able to measure renal blood flow and is completely noninvasive and does not require contrast administration, intravascular devices or exposure to ionizing radiation. Unfortunately, we know that MRI examinations in ICU patients are unpractical, time-consuming and expensive. Even further away from clinical application is another technique called two-photon microscopy. In animals, this technique was demonstrated to provide high resolution three-dimensional information that allows cellular imaging several hundreds of microns deep in extremely complex heterogeneous organs, such as the kidney [12,13]. Recent developments in intravital multiphoton studies within the kidney now allow investigators to utilize unique techniques and multiple fluorescent probes to visualize the functioning kidney which may lead to enhanced understanding of the pathophysiology of AKI [12,14]. Possible types of data that can be acquired using multiphoton imaging of the kidneys are cell injury in necrosis and apoptosis, glomerular filtration, endothelial permeability and local vasoconstriction. Although multiphoton imaging in AKI is still in its infancy, it is promising as an additional tool in diagnosing human AKI in the future.

In conclusion, TJRB is unlikely to become a frequently performed procedure in the ICU and the potential complications should be carefully weighted against the possible advantages and therapeutic consequences of a definite diagnosis in every ICU patient with a deteriorated renal function. Nevertheless, the case report of Javaid et al. shows that in selected patients where renal tissue is needed to reach a definitive diagnosis, TJRB is a diagnostic option that should be considered.
References