Ultrasound Imaging in Acute and Chronic Kidney Disease

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Ultrasound Imaging in Acute and Chronic Kidney Disease
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Ultrasound Imaging in Acute and Chronic Kidney Disease

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Preface

Ultrasound imaging techniques today represent a complementary yet indispensable tool in the process of diagnosis and care of kidney disease. Ultrasound machines are available in most departments of intensive care and nephrology, and their use has become a routine for clinicians directly involved in patient care rather than being procedures reserved only to experienced radiologists. The so-called ‘Visual Medicine’ is becoming part of the core curriculum of several disciplines and nephrology is one of the most advanced fields in this endeavor. The evolution of ultrasound equipment into smaller and flexible devices, has further contributed to the expansion of application of sonography in the process of diagnosis. The growing demand for education and training in this area has prompted us to develop this volume, timely published by Karger, in the book series ‘Contributions to Nephrology’.

New generations of physicians and nurses consider renal echography to be an expansion of their physical examination of the patient, making portable ultrasound equipment similar to what the stethoscope has been in the last century. This visionary approach requires the inclusion of visual medicine in the core curriculum of young physicians and nurses to make them acquainted with the newest techniques and the potential of the imaging approach to diagnosis.

Nephrology is a subspecialty of medicine that will gather specific advantages from the wide application of ultrasound diagnostic techniques. The kidney is a deep organ in the abdomen and physical examination is often frustrating, if not useless, for the diagnosis of kidney problems. Echography has already demonstrated in recent years the enormous advantages for interventional practices such as kidney biopsy. Today, with the addition of Doppler techniques, US imaging in nephrology has further enhanced its importance.

Sonography is also important in the case of acute kidney diseases, allowing to expand the spectrum of diagnostic criteria and to trigger specific treatment strategies as in the case of acute urinary tract obstruction. The possibility to determine morphological parameters and at the same time to explore functional
aspects with contrast-enhanced or Doppler ultrasound techniques, is of great value in acutely ill patients especially in the case of oliguria. The non-invasive nature of the technique and the possibility to perform a morphological analysis without potentially toxic contrast media makes echography a technique of choice in patients at risk for acute kidney injury. Recently, further improvement has been achieved in contrast-enhanced ultrasound using non-toxic gas micro-bubbles as the image contrast enhancer. Another advantage of modern echography is the light weight of equipment, the easy transportability and the possibility to perform examinations at the bedside without the need of transporting the patient to radiologic departments or special imaging areas of the hospital.

Of course the wide application of echography in nephrology and critical care nephrology will require an investment in equipment and education of physicians and nurses. It remains obvious that ultrasound will be a first-line approach for diagnosis while more sophisticated approaches and other imaging techniques will always require an experienced radiologist and large and expensive equipment. Nevertheless, the wider application of ultrasound techniques in clinical routine will allow to rule out at a first glance some important pathological conditions and to concentrate on an accurate diagnosis of the patient. Clinical and biochemical data should also corroborate the diagnostic pathway. Because the outcome of sonography is operator-dependent, special attention should be made to make as many specialists in the area of nephrology and intensive care acquainted with the technique. For this reason, we feel that this book may represent an important resource both for beginners and for advanced users of echography that will focus on their daily practice on diagnosis of kidney disease supported by ultrasound imaging techniques.

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Acute Kidney Disease


Pathophysiology and Clinical Work-Up of Acute Kidney Injury

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Abstract
Acute kidney injury (AKI), also known in the past as acute renal failure, is a syndrome characterized by the rapid loss of kidney excretory function. It is usually diagnosed by the accumulation of end products of nitrogen metabolism (urea and creatinine) or decreased urine output or both. AKI is the clinical consequence of several disorders that acutely affect the kidney, causing electrolytes and acid–base imbalance, hyperhydration and loss of depurative function. AKI is common in critical care patients in whom it is often secondary to extrarenal events. No specific therapies can attenuate AKI or accelerate renal function recovery; thus, the only treatment is supportive. New diagnostic techniques such as renal biomarkers might improve early diagnosis. Also ultrasonography helps nephrologists in AKI diagnosis, in order to describe and follow kidney alterations and find possible causes of AKI. Renal replacement therapy is a life-saving treatment if AKI is severe. If patients survive to AKI, and did not have previous chronic kidney disease (CKD), they typically recover to dialysis independence. However, evidence suggests that patients who have had AKI are at increased risk of subsequent CKD.

Definitions
The definition of acute renal failure (ARF) is usually used to describe a syndrome in which the rapid fall of glomerular filtration rate (GFR) determines retention of nitrogen catabolites with water and electrolyte imbalance and alteration in acid–base status. Loss of GFR leads to a rapid increase in serum