Contrast-Enhanced Ultrasound of the Urinary Tract

Giovanni Regine
Maurizio Atzori
Romano Fabbri

Springer

Contrast-Enhanced Ultrasound of the Urinary Tract

Giovanni Regine · Maurizio Atzori
Romano Fabbri

Contrast-Enhanced Ultrasound of the Urinary Tract

Springer

Giovanni Regine
Maurizio Atzori
Romano Fabbri
UOC Radiologia della Piastra
S. Camillo-Forlanini Hospital
Rome
Italy

ISBN 978-88-470-5430-1 ISBN 978-88-470-5432-5 (eBook)
DOI 10.1007/978-88-470-5432-5
Springer Milan Heidelberg New York Dordrecht London

Library of Congress Control Number: 2013937730

The contents of this book are based on: Ecocontrastografia dell'apparato urinario. G. Regine, M. Atzori, R. Fabbri © Springer-Verlag Italia 2012.

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

The ever-increasing return to the use of ultrasound contrast media has eliminated, or is in the process of eliminating, a kind of subordination of this method in comparison with other imaging technologies, such as TC or RM, considered to be more accurate, and therefore better for diagnosis. Yet, for a number of years now ultrasound has found its contrast media which, in the form of microbubbles, has given the technique a notable 'effervescence', opening the way for many new tools, both diagnostic and in the future probably also treatments, which were before unthinkable. Following the current growing interest, this paper seeks to analyze the applications of ultrasound using second-generation contrast enhancement for renal pathology, comparing our results with the current publications on the matter. The unique chemical and physical characteristics of the type of contrast chosen, combined with the use of specially designed software which is now standard on most middle-to high-grade ultrasound equipment, appear to be advantageous particularly in the evaluation of ischemic or traumatic pathology and in the characterization of cystic renal lesions. Another application now validated is in the follow-up after a kidney transplant, allowing for the identification of potential early or late complications, when used with perfusion indexes.

The most recent applications include the attempt to identify solid renal lesions and to define the T parameter in the staging of bladder lesions. Uses of the technique that are still 'unofficial' include evaluations of the vesicoureteral reflux in pediatric patients, and in general, all uses in the pediatric field.

The authors, delineating their experience based on a retrospective evaluation of the cases they have seen, hope to have produced something useful for those who have dedicated themselves to the use of microbubbles, or plan to do so, in the daily challenges of diagnostics that await them, whether experts or beginners. They also express their deep gratitude to their colleagues at the "Unità Operativa", in particular Dr. Simonetta Pascoli, untiring proponent of the method, as well as T. S. R. M Carlo Pace for the technological assistance which was vital for the present contribution.

Rome, May 2013

G. Regine
M. Atzori
R. Fabbri

Contents

Introduction

1

1.1 Introduction

One can find many published studies on the use of second-generation ultrasound contrast media (UCM) for kidney disease, but in recent years there have been an increasing number of publications regarding applications for other organs: the kidney, small intestine, pancreas, testes, and prostate [1]. The reason for this shift is in the unique chemical and physical characteristics of the contrast medium employed, which in this case is comprised of sulphur hexafluoride microbubbles with a diameter of 2–5 μm. Because of their size, once introduced into the blood stream they cannot be diffused into extravascular spaces. Thus, they take on similar characteristics to blood-pool contrast media, with the difference that they can pass through the pulmonary alveolar-capillary membrane and therefore be disposed of primarily through the respiratory process. This means of elimination makes second-generation CM recommendable for patients with renal disease for the lack of nephrotoxicity in the microbubbles [2]. Another feature of second-generation CM is the very low incidence of allergic reactions compared to gadolinium-based or iodinated CM. Currently, its use is indicated as unsafe in cases of: recent heart attack (<7 days), right to left shunt, severe pulmonary hypertension, pregnancy, lactation, or severe cardiac disease (III/IV class) [3]. In the execution of a contrast-enhanced ultrasound, one can make use of a wide range of software original to the apparatus. The current most frequently used technique is that referred to as conservative, or non-destructive: the acoustic pressure applied does not cause the microbubbles to burst, but uses non-linear oscillation to generate the echo amplification of the ultrasound signal. The pressure is measured by the mechanical index (MI). The conservative method uses a low MI, in contrast with the past use of the destructive method, in which the amplified ultrasound signal was achieved, after having broken the microbubbles, by employing a raised MI with the intensity of the signal with a shorter duration [2, 4].

G. Regine et al., *Contrast-Enhanced Ultrasound of the Urinary Tract*,
DOI: 10.1007/978-88-470-5432-5_1, © Springer-Verlag Italia 2013

1.2 Research Method

In line with other published studies, the research method of urinary tract pathology we have chosen consists of a baseline evaluation, then integrated with color Doppler, and followed by the contrast-enhanced phase: access to a peripheral vein is used, usually the antecubital vein of the arm, first administering an intravenous (IV) bolus of 1.2 mL of Sonovue (Bracco SpA, Milano, Italia), followed by 10 mL of saline solution, if necessary, in a second bolus. The ultrasound systems we used are of the Siemens Sequoia brand (Siemens Medical Solutions, USA Inc., Mountain View, CA), with Cadence Pulse Sequencing (CPS) technology and a low mechanical index (<0.2) [4]. Sonograms were acquired through image recording with Picture Archiving and Communication System (PACS) using real time imaging for a varying duration, depending on the organ, ranging from 2 to 5 min, with an early arterial phase (the moment in which the arrival of microbubbles in the vascular renal hilum is first noted and the 20 s following), a late arterial phase (up to around 40 s) and a late/parenchymal phase (up to 5 min) [1, 3]. The images can be recorded not only by enhancing the contrast effect (AC method), but also by using a blended method in which the software also provides a grayscale B-mode version of the image (Fig. 1.1). Contrast-enhanced ultrasound, therefore, is multi-phased like computed tomographic (CT) and magnetic resonance (MRI), but allows, once the microbubbles are destroyed by color Doppler signal (using, if necessary, a second bolus) a more targeted image of the lesion-affected organ, on which basis it should be considered a dynamic process [5, 6]. All of the cases documented in the present publication were integrated with one or even two other methods of imaging, specifically with a TC exam (Aquilion, 64 rows, Toshiba, Japan) using multi-phase integrated technique reconstructing 3D ultrasound

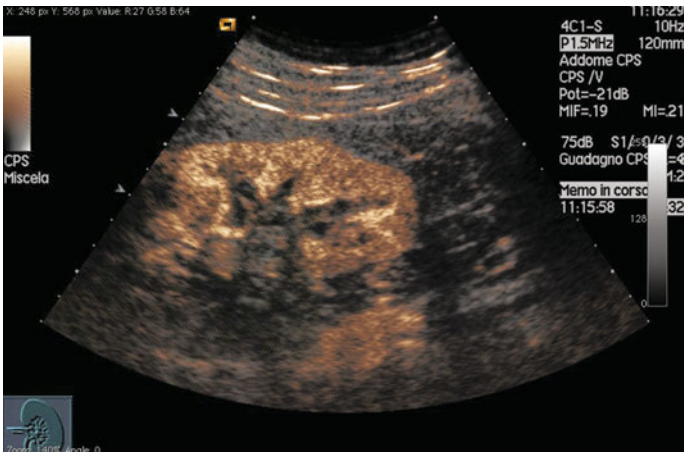

Fig. 1.1 Blended modality ultrasound exam: it is possible to see both the grayscale imaging, and the contrast effect of microbubbles