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Effect of Splenomegaly on Renal Resistive Index: Doppler Ultrasonograghy Study

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Abstract

Background and Aims: The Doppler resistive index was advanced as a useful parameter for quantifying the alterations in renal blood flow that may occur with renal diseases. The presence of splenomegaly is very significant in the diagnosis of several groups of diseases: immunological, inflammatory, reticuloendothelial proliferations, storage diseases and portal hypertension. This prospective study is designed to investigate whether there is an effect of splenomegaly on renal resistive index value of extrinsically compressed left kidney by using renal Doppler US.

Methods: A total of 48 patients (22 male and 26 female) with splenomegaly (>130 mm) were evaluated by renal Doppler US examination. The etiologies and durations of splenomegaly were found to be different. Renal sphericity indices were calculated for demonstration of extrinsic compression (long axis/short axis). The resistive index values obtained via both compressed left kidney by splenomegaly and contralateral right kidney were measured. Mean values were calculated and difference of mean resistive index between both kidneys were compared.

Results: The sphericity indices were higher in compressed left kidney (mean +/-SD) (2.4 +/- 0.4) than contralateral normal side (2.3 +/- 0.3). The mean RI of the compressed and contralateral kidney were 0.67 +/- 0.5 and 0.65 +/- 0.4, respectively. The mean RI value of the left side is statistically higher than right side ($p< 0.01$).

Conclusions: During renal Doppler examinations it should be kept in mind that the extrinsic pressure caused by enlarged spleen may significantly alter renal RI measurements.

Keywords: Renal Resistive Index, Splenomegaly, Doppler Ultrasonograghy

Introduction

The Doppler resistive index (RI) was advanced as a useful parameter for quantifying the alterations in renal blood flow that may occur with renal disease. A series of articles published during the past decade indicated the potential of Doppler ultrasonography (US) for improving the sonographic assessment of renal dysfunction. Changes in intrarenal arterial waveforms were shown to be associated with urinary obstruction, several types of intrinsic renal disorders, and renal vascular disease (1-6).

The presence of splenomegaly is very significant in the diagnosis of several groups of disease: immunological, inflammatory, reticuloendothelial proliferations, storage diseases and portal hypertension (7). Several complicated measurements have been described; however, no single, simple sonographic

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measurement gives a clinically useful indication of true splenic size (8-9). Splenomegaly is associated with downward displacement of the left kidney (10).

The RI is the product of the interaction of a number of factors, sometimes in a complicated manner. Knowledge of the normal range of RI value in the compressed kidney by splenomegaly is a prerequisite. This prospective study is designed to investigate whether there is an effect of splenomegaly on RI value of extrinsically compressed left kidney by using renal Doppler US.

Materials and Methods

During the two years period from May 2007 to December 2008 patients with splenomegaly with measurement of greater than 130 mm diameter in abdominal CT were included in this study. Informed consent was obtained from all the participants. The study was approved by the Institutional Review Board and met all guidelines of our institution. The patients with renal abnormalities in the abdominal CT are excluded from the study (stone disease, density difference in contrast enhancement, size difference, etc).

Renal Doppler US imaging was performed with a commercially available scanner (GE) with a 3.5-MHz sector transducer after CT examinations. Same experienced radiologist (SS) performed the Doppler US examination. Patients did not fast before the study and had normal hydration status. Both kidneys were examined in all patients. Thus, the right kidney was accepted as control group. Patient position was optimized to obtain renal images and Doppler tracings. First obtaining preliminary gray-scale images and renal sphericity indices (long axis/short axis) were calculated for demonstration of extrinsic compression. After that, three Doppler waveform tracings were obtained from each kidney by sampling the interlobar arteries in the superior, middle, and inferior portions of the kidney. Color Doppler US was used to help identify these arteries. The height of the pulsed Doppler waveform was maximized to facilitate measurement. A train of at least three similar, sequential Doppler waveforms was obtained during suspended respiration. The RI was measured on the waveforms from each renal area with use of electronic calipers and was calculated with the formula for RI ([peak systolic velocity – end diastolic velocity] / peak systolic velocity). In most patients the Doppler component of the examination lasted 10-20 minutes, although no absolute time limit was imposed on data collection. All Doppler studies were technically successful. The RI values obtained of both compressed left kidney by splenomegaly and contrlateral right kidney were measured. Mean RI values were calculated and difference of mean RI between two kidneys were compared. Three patients who have higher RI value in left kidneys underwent Tc-99m DTPA renal scintigraphy to investigate extrinsically compressed kidneys. We analyzed that there is no difference in the function of the left and right kidneys. Therefore we stopped the scintigraphic examination of the other patients.

Statistical analysis was performed with Wilcoxon test. A p value < 0.05 was regarded as statistically significant.

Results

A total of 48 patients (22 male and, 26 female) 26-74 years old (mean: 54 years old) with splenomegaly (>130 mm) were evaluated by renal Doppler examination. The etiologies and durations of splenomegaly were various: hepatic cirrhosis (15), chronic infection (10) lymphoma (9), leukemia (4), Budd Chiari Syndrome (2), portal vein thrombosis (2), Gaucher disease (2), Myelofibrosis (1). For the reason of different etiologies and different initial beginning symptoms, the exact development time of splenomegaly could not be found out.

The average spleen diameter of the patients was 175.4 -/+ 37.9 mm. As a proof of extrinsically compressed left kidney by splenomegaly the sphericity

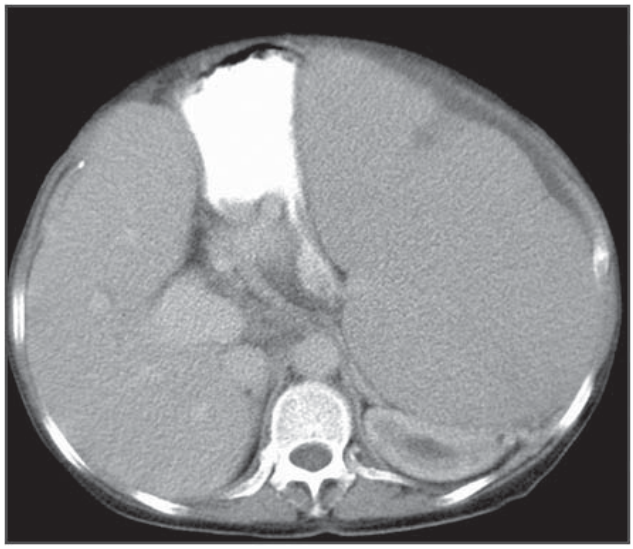

Figure 1a. Contrast enhenced axial CT of abdomen shows compressed left kidney by splenomegaly. The left side sphericity index is higher than right side.

indices were higher in compressed left kidney (2.4 +/- 0.4) (mean +/-SD) than contralateral normal side (2.3 +/- 0.3) (Figure 1).

The mean RI of the compressed and contralateral kidney were 0.67 +/- 0.5 and 0.65 +/- 0.4, respectively. The mean RI value of the left side is statistically higher than right side. ($p< 0.01$). In 32 patients the left RI value is higher then right RI value and in ten patients the right RI value is higher than left side. In 6 patients the RI values measured equal in both kidneys. The greatest difference in the RI values between right and left kidneys was 0.11.

Discussion

Doppler US measurement of the RI has become integral to US assessment of the kidneys in many institutions. The RI has been shown to change with a wide range of diseases, both intrinsic and extrinsic to the kidney and serves as a simple and a useful working index of renovascular resistance (1-6). The RI is the product of the interaction of a number of factors, sometimes in a complicated way. In general, most sonographers now consider 0.70 to be the upper threshold of the normal RI in adults (11-12). The average RI values in our study were in accordance with the literature. In order to evaluate the effect of spleen compression on the left kidney, the other possible etiologic pathologies that affect the RI were excluded.

The presence of splenomegaly is very significant in the diagnosis of several groups of disease including immunological, inflammatory, reticuloendothelial proliferations, storage diseases and portal hypertension. Splenomegaly may be associated with downward displacement of the left kidney (10). Several complicated measurement have been described. However, a single, simple sonographic measurement can give

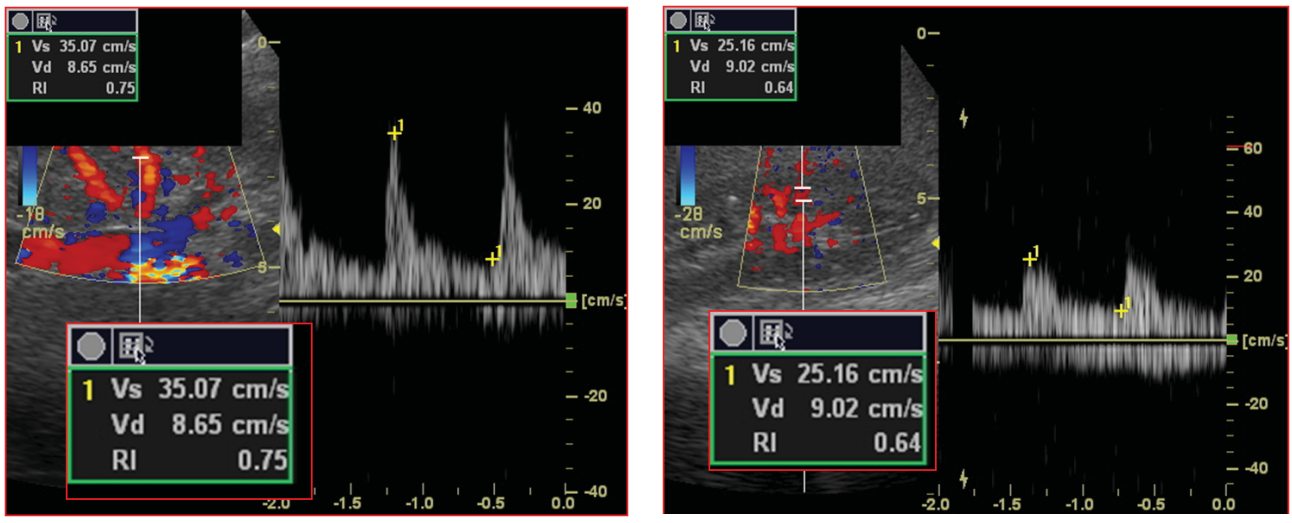

Figure 1b-c. Renal Doppler US demonstrates left side RI value is higher than right side.

clinically useful indication of the true splenic size (8-9). In our study we used the longitudinal axis of spleen as the criterion of splenomegaly.

The limitations of this study were having a heterogeneous group of patients and unknown duration of splenomegaly. Therefore we could not consider the relationship between the RI value and duration of splenomegaly.

We thought that the increase in the RI value of the left kidney in 32 patients was according to the increase of the renal vascular resistance as a result of decreasing vascular compliance by the compression of the renal parenchyma. It was almost universally accepted in the early Doppler literature that the RI varied directly with changes in renal vascular resistance (13-16). In many reports, the terms "resistive index" and "renal vascular resistance" are used interchangeably, although the relationship between these factors and other potentially confounding variables has, generally, not been considered (13-14). A series of in vitro experiments recently performed has convincingly shown the importance of vascular compliance in RI analysis (14-16).

In patients who have the increased RI on the right side and same RI values on both kidney, different complicated mechanisms might play a role in this chronic adaptive process.

In conclusion the compression on left kidney due to splenomegaly may change the renal resistive index value. During the renal Doppler examination, it should be considered that the left renal RI value could be higher than that of right side in patients with splenomegaly. Further studies with large series are needed to evaluate the real effect of the compression due to splenomegaly on left kidney and to consider the association among the volume of spleen, renal sphericity index and the duration of the splenomegaly.

Conflict of Interest

None declared.

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