Doppler Ultrasound of the Kidney

Chang-Kyu Sung
Department of Radiology, Seoul National University College of Medicine,
SNU-SMG Boramae Medical Center, Seoul, Korea

Doppler ultrasound (US) is a very useful diagnostic tool for the evaluation of the kidney. Color and power Doppler US can demonstrate renal parenchymal perfusion and various vascular abnormalities. Spectral Doppler US provides information of peripheral renal vascular resistance. It can provide valuable hemodynamic information in various renal diseases including urinary tract obstruction, renal parenchymal disease, renal vascular disease, and renal tumor. Among Doppler indices, the resistive index (RI) ([peak systolic velocity – end diastolic velocity] / peak systolic velocity) is most commonly used as a parameter for quantifying the alterations in renal blood flow that may occur with renal disease. Although there is skepticism regarding the role of Doppler resistive index, it may still be a useful diagnostic tool to evaluate renal dysfunction. This presentation reviews renal Doppler ultrasound, focusing on a theoretic basis for understanding the Doppler arterial waveform and clinical usefulness in evaluating the severity of the disease in patients with autosomal dominant polycystic kidney disease.

Manuscript title: Gray-scale and Doppler ultrasonographic findings reflecting the disease severity in autosomal dominant polycystic kidney disease

Background: The purpose of this study was to identify the ultrasonographic findings reflecting the severity of the disease in patients with autosomal dominant polycystic kidney disease (ADPKD).

Materials and Methods: In 72 patients with ADPKD, resistive indices (RIs) and the severity of ultrasonographic morphological abnormalities such as renal severity index (RSI), modified RSI, and the sum of bilateral renal size were measured and correlated with clinical and laboratory findings including the presence of hypertension and serum creatinine concentration. RSI was calculated as sum of three component of both kidneys which include the number of cysts, the size of largest cyst, and the percentage of normal renal parenchyma. Modified RSI is the sum of RSI and the score according to the renal size of both kidneys.

Results: Mean RI in all patients was 0.62±0.09 (mean±1SD). RIs in hypertensive ADPKD patients (0.63±0.11) were higher as compared to normotensive patients (0.58±0.05) (p<0.05). Serum creatinine concentration representing renal function correlated significantly with RIs (r=0.630, p<0.01) and with RSIs (r=0.344, p<0.01). The correlation between renal size and serum creatinine concentration or RIs was relatively weak (r=0.232, r=0.298, respectively).

Conclusion: RI and RSI were useful parameters in the quantitative evaluation of the severity of the disease and they may reflect renal functional status in patients with ADPKD.
Detection of Transplant Kidney Perfusion Change with New Ultrasound Modality: A Novel Detector of Allograft Acute Rejection

Shuo-Meng Wang, Shih-Chieh Chueh, Ming-Kuen Lai, Nai-Kuan Chou, King-Jen Chang, Chiung-Nien Chen, Sun-Hua Pao, Yio-Wha Shau, Jeou-Jong Shyu

Department of Urology, 1Department of Surgery, National Taiwan University Hospital, 2Institute of Applied Mechanics, 3Department of Veterinary Medicine, National Taiwan University, Taipei, Taiwan, ROC

Introduction: Ultrasound has been a noninvasive tool to monitor graft condition which can apply 2-D image, color/power Doppler image and calculate resistance index (RI). However, serum creatinine (Cre) is still most satisfactory and available value for monitor of renal function. And at situation of serum creatinine elevating, biopsy is still the main tool to clarify pathology diagnosis, albeit inevitable complication. A new ultrasound index using power Doppler to calculate ratio of percentage of vascularity (namely PDVI, power Doppler vascular index) at systolic (PDVI_{sys}) and diastolic (PDVI_{dia}) among renal cortex, namely renal vascular perfusion index (RVPI).

Materials and Methods: Between 2006 and 2008, ultrasound was performed in 203 cases with functional kidney transplantation. Patients were enrolled with stable renal function and in cases with elevated serum creatinine (more than 20% elevation). Twenty six cases of acute rejection were diagnosed with biopsy.

Results: RVPI has good correlation with renal perfusion with calculated creatinine clearance (p=0.00). Acute rejection predictive model was calculated with parameter of RVPI and Cre. RVPI is a significant predictor with OR 1.65. When RVPI cut point is set 3 and 4, RVPI has sensitivity of 59.2% and 74.1% and specificity of 58.4% and 71.4%. The negative predictive value is 69.3% and 94.7%.

Conclusions: RVPI is potentially a new model to detect of graft kidney perfusion change which is a sign of acute rejection. This non-invasive method is a inexpensive and valuable method to facilitate clinical evaluation of graft kidney at bed side in the near future.
Primary Aldosteronism: Change of Cystatin C Based Kidney Filtration and Renal Duplex Indices with Treatment

Vin Cent Wu
Departments of Internal Medicine, National Taiwan University Hospital.
National Taiwan University Hospital, Taipei, Taiwan

Context: Glomerular damage is a common feature revealed by a microalbuminuria or hyperfiltration in aldosteronism. Cystatin C was considered to be superior to creatinine in detecting chronic kidney disease.

Objective: To examine the kidney function change as defined as cystatin C based estimating glomerular filtrating equations (Cys-eGFR) and intra-renal Doppler velocimetric indices in primary aldosteronism after treatment.

Design: Prospective cohort study.

Results: Total of 130 patients (56 male; age, 49.9±13.4 years) had the diagnosis of PA, 100 with APA and 30 with IHA. Seventy-three patients identified (36 male; age, 51.4±14.8 years) as essential hypertension were invited for control. Kidney function estimated by cystatin C based eGFR (99.4 ± 21.2 ml/min/1.73 m²) decreased at 6m (93.7 ± 27.6 ml/min/1.73 m², p<0.01) and lasted to one year after adrenalectomy (88.6 ± 18.8 ml/min/1.73 m², p<0.01). Microalbuminuria deceased at one year after adrenalectomy. (0.31 ± 0.39 vs 0.16 ± 0.17 mg/mg, p<0.01) The Doppler indices, pulsatility index (1.2±0.24 vs 1.07±0.22, p<0.001) and resist index (0.66±0.069 vs 0.66±0.069, p<0.001) also decreased after adrenalectomy. Patients with EH showed no significant GFR, microalbuminuria or Doppler indices change after one year hypertensive drugs treatment.

Conclusions: Our data suggest that the pathophysiology of aldosterone related hyperfiltration would rather be attributable to the both reversible structural change and intra-renal vascular resistance only.

Key Words: Primary aldosteronism, cystatin C, hyperfiltration, microalbuminuria, Doppler indices
Application of Ultrasound in Andrology

Yu Chen

Department of Urology, Chang Gung Memorial Hospital, Linkou, Taiwan

Andrology is defined as the branches of science and medicine dealing mainly with reproductive and erectile functions of the male under physiological and pathological conditions. Ultrasound is widely used for diagnostic purposes in andrology. It serves as a non- or minimally invasive technique that does not produce ionizing radiation, which actually damage the reproductive organs such as the testis deeply, and can produce accurate and high quality imaging. So it is commonly used for imaging the major organs involved in andrology such as prostate, seminal vesicles, testis, scrotum, and penis etc. Transrectal sonography of the prostate and the seminal vesicles at a frequency of 5 to 7 Mhz had a firm place in the diagnosis of benign prostatic hyperplasia, prostate cancer, prostatitis, hypogonadism, and obstructive male infertility etc. Sonography is an important modality for imaging testicular and scrotal disorders at a frequency of 5 to 10 Mhz in the diagnosis of anorchia, atrophy testis, orchitis, epididymitis, cryptorchidism, testicular tumor, hydrocele, and varicocele which has become increasingly important for the screening of the patients with fertile and erectile dysfunction. Otherwise, color Doppler sonography can characterize blood flow to the testes and can be used to identify the etiology of acute scrotal pain. Ischemic pain, as would present with testicular torsion, can be separated from hyperemic pain, associated with inflammation or infection. On the other hand, traumatic injury to the scrotum can be investigated sonographically with the findings of hematoma, hydrocele, hematocele, and testicular rupture that may result with future fertile or erectile dysfunction. Color-coded duplex sonography is a main tool to be used in the differentiation of artery insufficiency type with venous occlusive type erectile dysfunction. Furthermore, it can be used to confirm the diagnosis of traumatic penile fracture too.
Comparison of Transrectal Ultrasonography for Patients Benign Prostatic Hyperplasia Before and After Transurethral Resection of Prostate

Shiuo-Sheng Chen
Division of Urology, Taipei City Hospital Ren-Ai Branch

Aim: Transrectal ultrasonography (TRUS) is a good modality for measuring prostate weight for benign prostatic hyperplasia (BPH) before surgical intervention. In order to compare the difference of TRUS for patients with BPH before and after transurethral resection of prostate (TURP), we made a prospective study. Patients and methods: From January 2003 to March 2008, TRUS were done in 90 men with symptomatic BPH before, 16 weeks, 12 months and 24 months after TURP. 90 patients were divided into two groups: group A (49 patients without extension of prostate into urinary bladder) and group B (41 with extension of prostate into urinary bladder). The estimated prostate volume calculated by TRUS equals 0.52 x length (L) x width (W) x height (H), and shrinkage ratio (%) is prostate volume after TURP/ prostate volume before TURP. Results: The estimated prostate size were 44.3 ± 17.2, 20.5 ± 10.3, 37.9 ± 14.5 and 38.4 ± 15.1 cm3 in that of patients with BPH before, 16 weeks, 12 months and 14 months after TURP, respectively. The shrinkage were 56.1 ± 22.4, 84.8 ± 19.3 and 85.5 ± 20.2 % 16 weeks, 12 months and 24 months after surgery, separately. Significant decrease of the prostate volume was noted for all the 90 patients 16 weeks after surgery as compared with that before surgery (p<0.05), but significant reduction of the prostate size 12 and 24 months after operation was noticed only for patients of group B, but not for patients of group A. Conclusion: The prostatic volume shrunk significantly 16 weeks after TURP in all patients, but the size would expand 12 and 24 months after surgery.

Color Doppler Ultrasound Diagnosis of Pesudoaneurysm in Allogeneic Renal Transplantation Over 12 Years Ago with Spontaneous Graft Vessel Leakage-Case Report

Kai-Lun Cheng1,2, Tung-Lin Tsui3, Kwo-Cheng Ueng3, Horng-Rong Chang4, Yu-Lin Kao5, Yeu-Sheng Tyan1,2, Teng-Fu Tsao1,2
1Department of Medical Imaging, Chung Shan Medical University Hospital 2School of Medical Imaging and Radiological Sciences, Chung Shan Medical University 3Division of Cardiology, Department of Medicine, Chung Shan Medical University Hospital 4Division of Nephrology, Department of Medicine, Chung Shan Medical University Hospital 5Department of Urology, Chung Shan Medical University Hospital

The vascular complication is a significant proportion (up to 12.5%) of patients following renal transplantation and is a contributory cause of graft dysfunction. However, pseudoaneurysm is rare, having been reported in around 1% of the renal transplant population. Angiography is regarded as the gold standard in the diagnosis of vascular complications. Color Doppler ultrasound provides an additional, non-invasive method to detect and monitor the vascular lesion after renal transplantation. The swirl pattern of blood flow in the vascular lumen is considered as the “Yin Yang sign” and is characteristic of aneurysm or pseudoaneurysm. Herein, we report a rare case of spontaneous graft vessel leakage with pseudoaneurysm formation after renal allograft over 12 years ago. Color Doppler ultrasound, CT images, and angiogram are reviewed.