

Supplemental Materials

The performance of flash-replenishment contrast enhanced ultrasound for the qualitative assessment of kidney lesions in patients with chronic kidney disease

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SUPPLEMENTAL FIGURES AND TABLES

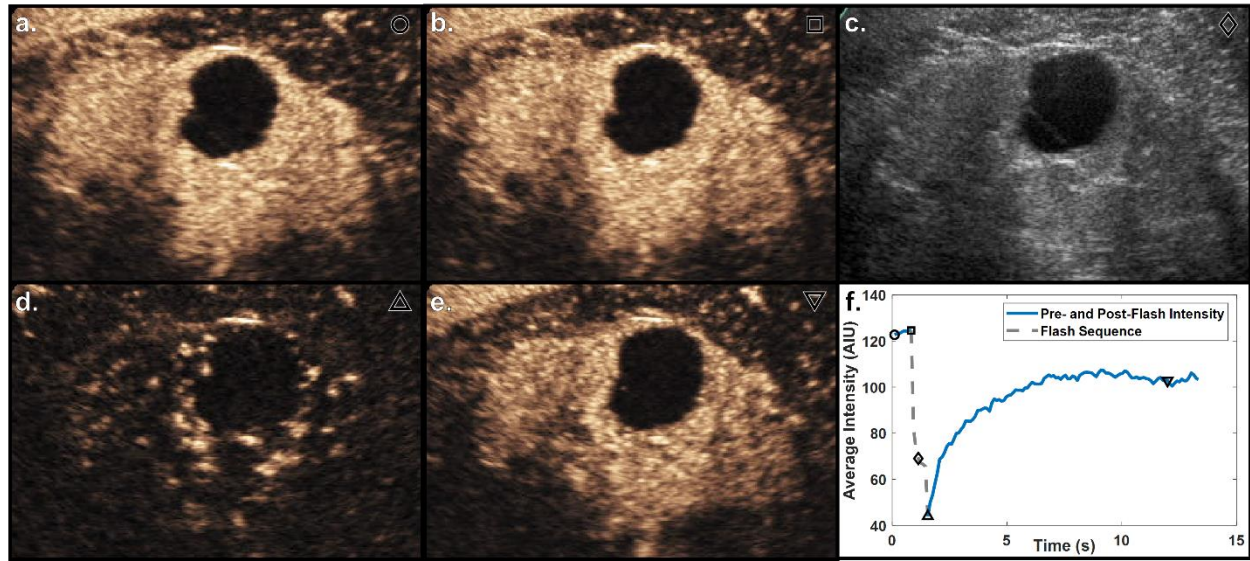


Figure S1. A series of images demonstrating the flash replenishment imaging technique. Symbols in the upper right-hand corner of a-e) correspond to their location on the graph of intensity vs. time in f). a) Contrast intensity after reaching steady state equilibrium via a constant infusion of Perflutren Lipid Microspheres, b) the intensity immediately prior (pre-flash) to initiating a high pressure pulse to clear contrast from the kidney, c) the high pressure pulse, or flash, is generated by briefly switching to color doppler imaging, d) the first frame (post-flash) after returning to a low-pressure contrast imaging mode, where contrast can be seen beginning to refill the kidney, e) the contrast intensity as it returns to the original steady state value, and f) a graph of intensity over time in the kidney which represents the flash replenishment imaging technique.

Table S1. Characteristics of all enrolled patients

Patient Characteristics (N = 60)	N (%)
Age (years)	
Mean \pm SD	60 \pm 14
Sex	
Male	37 (61.7%)
Female	23 (38.3%)
Race or Ethnicity	
Black	30 (50.0%)
White	29 (48.3%)
Hispanic	1 (1.7%)
CKD Stage	
CKD II	9 (15%)
CKD III	18 (30%)
CKD IV	11 (18.3%)
CKD V	5 (8.3%)
ESKD	17 (28.3%)
Initial Imaging Study	
Non-contrast CT	3 (5.0%)
Contrast CT	2 (3.3%)
Contrast CT with renal mass protocol	12 (20%)
Non-contrast MRI	3 (5.0%)
Contrast MRI	3 (5.0%)
Conventional US	37 (61.7%)

Abbreviations: CKD (chronic kidney disease), ESKD (end-stage kidney disease), CT (computed tomography), MRI (magnetic resonance imaging), US (ultrasound)

Table S2. Number, diagnosis, laterality, and size of analyzed lesions

Lesion Information (N = 63)	N (%)
Lesion Diagnosis	
Clear cell RCC	2 (3.2%)
Acquired cystic disease RCC	4 (6.4%)
Papillary RCC	2 (3.2%)
Clear cell papillary RCC	2 (3.2%)
Tubulocystic RCC	1 (1.6%)
Oncocytoma	1 (1.6%)
<i>Imaging Surveillance</i>	
Stable: Regressed/no concerning features	40 (63.5%)
Suspicious: Stable, but persistent concerning features	8 (12.7%)
Progressed: Progressed features	3 (4.7%)
Laterality of Lesion¹	
Left	30 (47.6%)
Right	33 (52.4%)
Lesion Measurements by Imaging (cm³, cm)²	
Average Volume \pm SD (range)	10.8 \pm 14.3 (0.15-85.4)
Median Volume (IQR)	5.97 (11.4)
Average Minimum Diameter (range)	2.06 (0.60-4.40)
Average Maximum Diameter (range)	2.72 (0.80-6.90)

¹Lesion laterality is indicated based on each individual lesion/case, regardless of if bilateral disease was present in patients with multiple lesions imaged for this study. ²Some values are reported to two decimal places to retain a minimum of two significant figures for numbers other than exact numbers.

Abbreviations: RCC (renal cell carcinoma), IQR (interquartile range)

Table S3. Inter-reader agreement on lesion characterization

	Reader 1	Malignant (n = 36*)	Indeterminate (n = 5*)	Benign (n = 22*)	P-value
Reader 2	Malignant	26 (72%)	2 (40%)	1 (4.5%)	0.2
	Indeterminate	10 (28%)	1 (20%)	1 (4.5%)	
	Benign	0 (0%)	2 (40%)	20 (91%)	
Reader 3	Malignant	27 (75%)	1 (20%)	2 (9.1%)	0.3
	Indeterminate	6 (17%)	1 (20%)	2 (9.1%)	
	Benign	3 (8.3%)	3 (60%)	18 (82%)	
Reader 4	Malignant	27 (75%)	1 (20%)	4 (18%)	0.4
	Indeterminate	6 (17%)	4 (80%)	0 (0%)	
	Benign	3 (8.3%)	0 (0%)	18 (82%)	

	Reader 2	Malignant (n = 29*)	Indeterminate (n = 12*)	Benign (n = 22*)	P-value
Reader 3	Malignant	23 (79%)	6 (50%)	1 (4.5%)	0.7
	Indeterminate	4 (14%)	4 (33%)	1 (4.5%)	
	Benign	2 (6.9%)	2 (17%)	20 (91%)	
Reader 4	Malignant	26 (90%)	4 (33%)	2 (9.1%)	0.8
	Indeterminate	2 (6.9%)	6 (50%)	2 (9.1%)	
	Benign	1 (3.4%)	2 (17%)	18 (82%)	

	Reader 3	Malignant (n = 30*)	Indeterminate (n = 9*)	Benign (n = 24*)	P-value
Reader 4	Malignant	25 (83%)	5 (56%)	2 (8.3%)	0.6
	Indeterminate	4 (13%)	2 (22%)	4 (17%)	
	Benign	1 (3.3%)	2 (22%)	18 (75%)	

*Percentages totaled by column, for each individual reader compared to the section header

Table S4. Contrast ultrasound data quality assessment of interpreted cases (N = 65) by reader

Suggestion	Reader 1	Reader 2	Reader 3	Reader 4
No suggested changes	48	24	47	48
Higher contrast dose	3	13	3	4
Lower contrast dose	0	1	0	0
Longer imaging	1	0	0	2
Adjust gain	1	2	6	2
Different view	11	21	8	1
Other major adjustments	0	0	0	3
Other minor adjustments	1	4	1	5