

VALIDATION OF THE USE OF REGION OF INTEREST (ROI) MEASUREMENTS FOR OBJECTIVE ASSESSMENT OF POST- CONTRAST ENHANCEMENT OF RENAL LESIONS ON MAGNETIC RESONANCE IMAGING (MRI)

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BACKGROUND

- MRI IS A PROBLEM SOLVING IMAGING TOOL AFTER EXHAUSTING US AND CT FOR THE EVALUATION OF RENAL LESIONS
- WHILE THE USE OF ROI MEASUREMENTS IN CT IS WELL ESTABLISHED, RADIOLOGISTS ARE RELUCTANT TO USE ROIs IN MRI
- THRESHOLD OF CHANGES IN ROI VALUES ON PRE- AND POST-CONTRAST MRI IMAGES IS NOT WELL ESTABLISHED
- WIDELY USED SUBTRACTION IMAGES - PRONE TO MISREGISTRATION ARTIFACT DUE TO BREATHING AND MOTION

OBJECTIVE

- TO **VALIDATE** THE UTILIZATION OF REGION OF INTEREST (ROI) MEASUREMENTS IN (MRI) TO **OBJECTIVELY** ASSESS FOR **ENHANCEMENT** IN SUSPECTED SOLID RENAL MASSES AND TO **DETERMINE A MINIMUM THRESHOLD VALUE** FOR TRUE ENHANCEMENT

METHODS

- RE-EVALUATION OF PREVIOUSLY ACQUIRED RENAL MRI STUDIES
- 104 CONSECUTIVE PATIENTS WHO UNDERWENT RENAL MRI AT OUR INSTITUTION WERE INCLUDED
- SUBSEQUENT BIOPSY AND/OR PARTIAL/RADICAL NEPHRECTOMY
- PERIOD: JANUARY 2015 TO DECEMBER 2017
- RESEARCH ETHICS BOARD APPROVAL OBTAINED

METHODS

INCLUSION CRITERIA:

- 1) PATIENTS WHO HAD RENAL MRI AT ST. JOSEPH'S HEALTHCARE HAMILTON
- 2) PATIENTS WHO HAD BIOPSY AND/OR PARTIAL/RADICAL NEPHRECTOMY

EXCLUSION CRITERIA:

- 1) MISSING POST-CONTRAST SEQUENCES ON MRI
- 2) SIGNIFICANT ARTIFACT ON THE MRI SEQUENCES
- 3) NON-DIAGNOSTIC BIOPSY, LACK OF PATHOLOGY INFORMATION

METHODS

- 2 READERS INDEPENDENTLY MEASURED THE MEAN ROI FOR RENAL MASSES/LESIONS ON THE PRE- AND FIRST POST- CONTRAST (AT 60 SECONDS) MR SEQUENCES
- INTERNAL VALIDATION FOR ROI MEASUREMENTS:
 - NORMAL IPSILATERAL RENAL PARENCHYMA
 - NORMAL IPSILATERAL PSOAS MUSCLE
 - EXTERNAL AIR

METHODS

- ABSOLUTE AND PERCENTAGE CHANGE IN MEAN ROI VALUES ON THE PRE- AND POST-CONTRAST SEQUENCES WERE CALCULATED
- READERS WERE BLINDED TO FINAL PATHOLOGY REPORT
- INTER-OBSERVER AGREEMENT WAS CALCULATED USING COHEN'S KAPPA TEST

EXAMPLE

T1-Pre C



T1-Post C



T1-Subtraction



Is there an enhancing nodule?

EXAMPLE

T1-Pre C



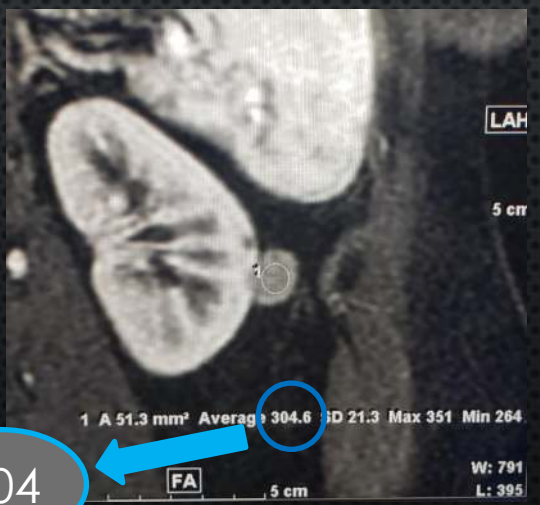
T1-Post C



T1-Subtraction



309



304



113

- THE PREVIOUS EXAMPLE OF A CYST WITH HEMORRHAGIC OR PROTEINACEOUS CONTENT DEMONSTRATING INHERENT T1 HYPERINTENSE SIGNAL. THE MEASUREMENT OF ROI BEFORE AND AFTER ADMINISTRATION OF IV CONTRAST DEMONSTRATES NO SIGNIFICANT CHANGE IN THE VALUES.
- SUBTRACTION IMAGE: MIS-REGISTRATION (SHOULD NOT BE INTERPRETED AS THICK ENHANCING WALL OR ENHANCING MURAL NODULE)
- PLEASE NOTE: PRE- AND POST-CONTRAST SEQUENCES SHOULD HAVE SIMILAR PARAMETERS TO BE ABLE TO USE THEM FOR ACCURATE ROI MEASUREMENTS

RESULTS

- 113 PATIENTS INCLUDED INITIALLY
- 9 PATIENTS WERE EXCLUDED: 1 SUBOPTIMAL POST-CONTRAST IMAGES, 2 UNDERWENT NEPHRECTOMY PRIOR TO MRI, 1 SMALL LESION (< 1 CM), 2 NO IV CONTRAST ADMINISTERED, 2 PREDOMINANTLY FATTY MASSES (AML), 1 POST ABLATION MRI
- 104 PATIENTS ULTIMATELY INCLUDED
- MEAN AGE: 65 YEARS (AGE RANGE 24-83)
- 58 MALES, 46 FEMALES

RESULTS

- LESIONS SIZE RANGE: 1.1-13.4 CM
- 74 PATIENTS HAD RCC (71%):
 - CLEAR CELL RCC: 55%
 - PAPILLARY RCC: 22%
 - OTHER RCC SUBTYPES: 23%
- NON-RCC LESIONS: 30 PATIENTS (29%):
 - ONCOCYTOMAS
 - RENAL PAPILLARY ADENOMA
 - RENAL METASTASIS

RESULTS

- MINIMUM PERCENTAGE CHANGE IN ROI VALUES [**SIGNAL INTENSITY INDEX**] BETWEEN PRE- AND POST-CONTRAST IMAGES IN PATH-PROVEN RCCs: **23% (RANGE 23-437%)**
- PERCENTAGE CHANGE FOR NORMAL RENAL PARENCHYMA: 32-317%
- MAXIMUM PERCENTAGE CHANGE IN PATH-PROVEN BENIGN CYSTS: 13%
- INTER-OBSERVER AGREEMENT: κ 0.84 (EXCELLENT AGREEMENT)

RESULTS

	No. of cases	Absolute change in Lesions ROI post Gad		Percentage Change in Lesions ROI [Signal Intensity Index]	
		Min.	Max.	Min.	Max.
All RCC	74	28	766	23%	437%
Clear Cell RCC	41	36	766	26%	437%
Papillary RCC	16	49	511	23%	316%

LITERATURE REVIEW

Renal Masses: Quantitative Assessment of Enhancement with Dynamic MR Imaging

Vincent B. Ho, Scott F. Allen, Maureen N. Hood, Peter L. Choyke

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- 74 PATIENTS: 50 SOLID LESION AND 50 RENAL CYSTS
- THE SOLID MASSES HAD PATHOLOGY CORRELATION. HOWEVER, CYSTS WERE ONLY CONFIRMED BY OTHER IMAGING MODALITIES LIKE CT AND US.
- 15% CHANGE ROI THRESHOLD, TIMING 2-4 MINUTES AFTER ADMINISTRATION OF IV CONTRAST

CONCLUSION

- THE PERCENTAGE CHANGE IN ROI VALUES (**SIGNAL INTENSITY INDEX**) CAN BE A HELPFUL TOOL IN THE OBJECTIVE ASSESSMENT OF TRUE ENHANCEMENT OF RENAL MASSES AND CAN SUPPLEMENT SUBTRACTION IMAGES.
- A CUT-OFF SIGNAL INTENSITY INDEX OF 20% CAN BE USED TO ESTABLISH TRUE ENHANCEMENT IN A SUSPECTED SOLID MASS

CLINICAL RELEVANCE

- AN ADDITIONAL OBJECTIVE TOOL TO ASSESS ENHANCEMENT OF RENAL LESIONS MAKES THE RADIOLOGIST MORE CERTAIN IN THEIR DIAGNOSIS AND HELPS FURTHER MANAGEMENT

LIMITATIONS

- A SINGLE CENTER AND TWO MR VENDORS EXPERIENCE
- NUMBER OF PATHOLOGY PROVEN RENAL CYSTS IS LIMITED

REFERENCES

- VINCENT B. HO, SCOTT F. ALLEN, MAUREEN N. HOOD, PETER L. CHOYKE. RENAL MASSES: QUANTITATIVE ASSESSMENT OF ENHANCEMENT WITH DYNAMIC MR IMAGING. RADIOL.2243011048
- FAWAZ AL HARBI, LEILA TABATABAEFFAR, MICHAEL A. JEWETT, ANTHONY FINELLI, MARTIN O'MALLEY, MOSTAFA ATRI. ENHANCEMENT THRESHOLD OF SMALL (<4CM) SOLID RENAL MASSES ON CT. AMERICAN JOURNAL OF ROENTGENOLOGY. 2016;206: 554-558. 10.2214/AJR.15.14806