TO ASSESS THE ROLE OF DWI IN CHARACTERIZING THE RENAL NEOPLASMS INTO THE VARIOUS SUBTYPES USING THE ADC VALUES OF THE LESIONS AND FINDING ITS ACCURACY BY HISTOPATHOLOGICAL CORRELATION.

Dr. Nitin Kumar Tripathi¹ (Consultant Radiologist) & Dr. Sanjay Kumar Tekam² (Consultant Radiologist)

Dept. of Radio-diagnosis, M.G.M. Medical College, & M.Y. Hospital, Indore, Madhya Pradesh^{1&2}

Article Info: Received 03 September 2020; Accepted 05 October 2020

DOI: <https://doi.org/10.32553/ijmbs.v4i10.1451>

Corresponding author: Dr. Sanjay Kumar Tekam

Conflict of interest: No conflict of interest.

Abstract

This prospective study was done in the Department of Radiodiagnosis at M.G.M. Medical College, & M.Y. Hospital, Indore. A total of 40 patients who were referred to our department with strong clinical suspicion of renal lesion and those diagnosed by ultrasonography or contrast enhanced CT scan having a renal mass on either of them, were subjected to a non-contrast. ADC values are expressed in $10^{-3} \text{ mm}^2/\text{s}$. DW imaging with ADC values allows differentiation of clear cell, papillary and chromophobe subtypes of RCCs, suggesting that DW imaging may be a useful tool in the preoperative characterization of RCC. Hence, MRI with DWI in particular is a very valuable non invasive tool for the Identification, characterization and differentiation of renal lesions.

Study Designed: Observational Study.

Keywords: DWI, Renal, Neoplasms, ADC, Histopathological & Correlation.

Introduction

Diffusion is a physical property, which describes the microscopic random movement of (water) molecules driven by their internal thermal energy. This movement is known as Brownian motion. In biological tissues, water diffusion is movement of water molecules in intracellular, extracellular and intravascular spaces.¹ Diffusion is affected by the biophysical properties of tissue cell organization (cell membranes, fibers and macromolecules), density, microstructure and microcirculation. Intracellular water diffusion is more hindered than that in the extracellular spaces which are lacking natural barriers.

Pathological processes which change the volume ratio or physical nature of intra- and extracellular spaces affect the diffusion of water molecules. Restricted or impeded diffusion is seen in tissues with high cellularity, e.g. tumors, abscesses, fibrosis and cytotoxic edema. Relative free or unimpeded diffusion is encountered in tissues with low cellularity or tissues with disrupted cell membranes, for example in cysts and necrotic tissues.

Advances in MRI technique, Diffusion weighted imaging has been applied to renal examinations. Application of diffusion-weighted sequences in body imaging had been limited. However, with recent use of faster, more robust sequences, better image quality can be achieved, and diffusion-weighted imaging has shown great potential for use in abdominal imaging.²⁻⁴

Diffusion weighted MRI has an immense role in imaging renal masses. The Apparent Diffusion Coefficient (ADC) gives quantitative information in DW MRI and has been

shown to be inversely related to cellularity and grade of neoplasms.⁵⁻⁷ DW MRI can help in further characterization of renal mass lesions, in differentiating benign from malignant lesions and in subtyping of renal malignancies.

Material & Method

This prospective study was done in the Department of Radiodiagnosis at M.G.M. Medical College, & M.Y. Hospital, Indore. A total of 40 patients who were referred to our department with strong clinical suspicion of renal lesion and those diagnosed by ultrasonography or contrast enhanced CT scan having a renal mass on either of them, were subjected to a non-contrast

Magnetic Resonance Imaging evaluation of abdomen using 1.5 Tesla MRI Scanner after obtaining informed consent. The study was conducted from June 2016 to May 2017 after getting approval by Institutional Scientific Review Board.

Inclusion Criteria

1. Patients referred to our department with strong clinical suspicion of a renal lesion.
2. Patient having evidence of incidentally detected/symptomatic renal mass on ultrasound or CT scan.

Exclusion Criteria

1. Patients refusing to participate in the study.
2. Patients with mass lesions infiltrating the kidney from outside the kidney.
3. Patients with traumatic injury to kidney.
4. Severely ill patients who couldn't maintain adequate breath hold.

5. Patients with general contraindication to MRI such as those with pacemakers, cochlear implants and other electromagnetic implants in body.

FIG: 01 Coronal and Axial T 2 weighted images (A, B) show poorly defined lesions with heterogenous signal intensity in upper mid and lower pole of both kidney. Most of these lesions showed restricted diffusion on DWI (C) and mean ADC values of the lesions ($1.56 \times 10^{-3} \text{ mm}^2/\text{sec}$) was lower than that of normal renal parenchyma ($2.46 \times 10^{-3} \text{ mm}^2/\text{sec}$).

Results

TABLE 01: DWI AND ADC MAP FINDINGS

S. No.	TYPE OF LESION	DWI	ADC MAP
1.	ABSCCESS	HYPERINTENSE	HYPOINTENSE
2.	PYELONEPHRITIS	HYPERINTENSE	HYPOINTENSE
3.	COMPLEX CYST	HYPOINTENSE/ HYPERINTENSE	HYPERINTENSE/ HYPOINTENSE
4.	ANGIOMYOLIPOMA	HYPOINTENSE	HYPERINTENSE
5.	ONCOCYTOMA	HYPOINTENSE	HYPERINTENSE
6.	RCC	HYPERINTENSE	HYPOINTENSE
7.	TCC	HYPERINTENSE	HYPOINTENSE
8.	METASTASIS	HYPERINTENSE	HYPOINTENSE

TABLE 02: AVERAGE ADC VALUE OF RENAL LESIONS

S. No.	TYPE OF LESION	NO OF LESIONS	MEAN ADC VALUE
1	ABSCCESS	2	0.86
2	PYELONEPHRITIS	1	1.56
3	COMPLEX CYST	3	2.30
4	ANGIOMYOLIPOMA	5	1.72
5	ONCOCYTOMA	1	1.84
6	RCC	25	1.43
7	TCC	2	1.40
8	METASTASIS	1	0.95

ADC values are expressed in $10^{-3} \text{ mm}^2/\text{s}$.

Discussion

On MRI, lesions were identified using T1W, T2W and DWI sequences. Then, the lesions were characterized based on their appearance in these sequences and the ADC values of these lesions were calculated from the corresponding ADC maps.

On MRI Imaging, renal abscesses show hypointensity on T1 weighted images and hyperintensity on T2-weighted images. Their walls are thick and show significant surrounding edema. The abscess cavity consists of thick viscous contents with debris. Sepatations are also frequently encountered.

There were 2 cases of abscess in our study. Abscess show significant restriction of diffusion that appears bright on DWI and appears hypointense on ADC maps. This was also seen in studies by Goyal et al⁸ and Prettnner et al⁹. Only one case of pyelonephritis was found in our study. On MRI renal parenchyma appears heterogenous with affected lesions showing low signal intensity on T1-weighted images and high signal intensity on T2-weighted images. DW MRI showed areas of restricted diffusion that appear bright. ADC values of affected area was significantly lower

than the normal renal parenchyma. This was also seen in study by Rathod et al¹⁰.

The MRI features of simple cystic renal masses was hypointense on T1 and hyperintense on T2 weighted images. They were homogenous and thin walled. Complex cysts appeared thick walled and demonstrated internal septations, calcification or solid components. We had 3 complex cyst in our study out of which one was hemorrhagic complex cyst. Hemorrhagic cysts appeared as sharply marginated, round, homogeneous lesions. They have high signal intensity on both T1- and T2-weighted sequences. They also showed diffusion restriction. Complex cysts had the highest ADC values of all lesions with mean ADC values of $2.30 \pm 0.3 \times 10^{-3} \text{ mm}^2/\text{sec}$ with hemorrhagic cyst having comparatively lower ADC values. Similar findings were seen in studies by Prettnner et al⁹ and Zhang et al¹¹.

Angiomyolipoma was the most common benign lesion in our kidney constituting 13% (5) of lesions. MRI appearance of lesion was hyperintense on T1 and T2-weighted images due to high lipid content and low signal intensity on fat-suppression sequence. Opposed-phase imaging shows a characteristic India ink artifact at the interface between the mass and the normal renal parenchyma¹². Lipid-poor angiomyolipomas frequently demonstrate homogeneous low signal intensity relative to the renal parenchyma on T2-weighted images. Average ADC value of angiomyolipoma in our study was $1.72 \pm 0.2 \times 10^{-3} \text{ mm}^2/\text{sec}$. Angiomyolipoma showed homogenous signal intensity on diffusion weighted imaging. Similar findings on MRI were seen in studies by Prettnner et al⁹ and Tanaka H et al¹³.

Conclusion

DW imaging with ADC values allows differentiation of clear cell, papillary and chromophobe subtypes of RCCs, suggesting that DW imaging may be a useful tool in the preoperative characterization of RCC. Hence, MRI with DWI in particular is a very valuable non invasive tool for

the Identification, characterization and differentiation of renal lesions.

References

1. Hagmann P, Jonasson L, Maeder P, Thiran JP, van Wedeen J, Meuli R. Understanding diffusion MR imaging techniques: from scalar diffusion-weighted imaging to diffusion tensor imaging and beyond. *RadioGraphics* 2006;26(suppl 1):S205–S223
2. Murtz P, Flacke S, Traber F, van den Brink JS, Gieseke J, Schild HH. Abdomen: diffusion-weighted MR imaging with pulse-triggered single-shot sequences. *Radiology* 2002; 224: 258–264
3. Yoshikawa T, Kawamitsu H, Mitchell DG, et al. ADC measurement of abdominal organs and lesions using parallel imaging technique. *AJR Am J Roentgenol* 2006; 187: 1521–1530
4. Feuerlein S, Pauls S, Juchems MS, Stuber T, Hoffmann MH, Brambs HJ, Ernst AS. Pitfalls in abdominal diffusion weighted imaging: how Predictive is restricted water diffusion for malignancy. *AJR Am J Roentgenol* 2009; 193:1070-1076.
5. Taouli B, Sandberg A, Stemmer A, Parikh T, Wong S, Xu J, Lee VS. Diffusion-weighted imaging of the liver: comparison of navigator triggered and breathhold acquisitions. *J Magn Reson Imaging* 2009 Sep; 30(3):561-8.
6. Mytsyk Y, Borys Y, Komnatska I, Dutka I, Shatynska-Mytsyk I. Value of the Diffusion-Weighted MRI in the Differential Diagnostics of Malignant Benign Kidney Neoplasms – Our Clinical Experience. *Polish Journal of Radiology*. 2014;79:290-295. doi:10.12659/PJR.890604.
7. Sasamori H, Saiki M, Suyama J, Ohgiya Y, Hirose M, Gokan T. Utility of apparent diffusion coefficients in the evaluation of solid renal tumors at 3 T. *Magn Reson Med Sci*. 2014;13:89–95. doi: 10.2463/mrms.2013-0038
8. Goyal A, Sharma R, Bhalla AS, Gamanagatti S, Seth A. Diffusion-weighted MRI in inflammatory renal lesions: all that glitters is not RCC! *European radiology*. 2013 Jan;23(1):272–279.
9. Pallwein-Prettnner L, Flöry D, Rotter CR, et al. Assessment and characterisation of common renal masses with CT and MRI. *Insights into Imaging*. 2011;2(5):543-556. doi:10.1007/s13244-011-0116-1.
10. Rathod S.B., Kumbhar S.S., Nanivadekar A., Aman K. Role of diffusion-weighted MRI in acute pyelonephritis: a prospective study. *Acta Radiol*. 2015;56:244–249.
11. Zhang J, Tehrani YM, Wang L, Ishill NM, Schwartz LH, Hricak H. Renal masses: characterization with diffusion-weighted MR imaging—a preliminary experience. *Radiology* 2008; 247: 458–464.
12. Israel G. M., Hindman N., Hecht E., Krinsky G. The use of opposed-phase chemical shift MRI in the diagnosis of renal angiomyolipomas.
13. Tanaka H., Yoshida S., Fujii Y., et al. Diffusion-weighted magnetic resonance imaging in the differentiation of angiomyolipoma with minimal fat from clear cell renal cell carcinoma.