Role of MRI diffusion in evaluation of renal masses

Essay

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﴿ بِسْمِ اللّهِ الرَّحْمنِ الرَّحِيمِ﴾

قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم

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MAI ABDELWAHED TAWFEEK

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To my Parents,
To my Husband,
To my Daughters &Son

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List of Abbreviations

- 2D: Two dimensional
- 3D : Three Dimensional
- 3 T : Three Tesla
- ADC: Apparent Diffusion Coefficient
- ADPKD: Autosomal dominant polycystic kidney disease
- AML: Angiomyolipoma
- ARPKD: Autosomal recessive polycystic kidney disease
- b: b Value
- CM: centimeter
- CT : Computed Tomography
- DWI: Diffusion weighted imaging
- DW-MR: Diffusion weighted- Magnetic resonance
- EPI: Echo planar imaging
- FS: Fast spin-echo
- g: gram
- GCKD: Glomerulocystic kidney disease
- GRAPPA: Generalized autocalibrating partially parallel acquisition
- GRE : Gradient echo
- HASTE : Half Fourier acquisition single shot turbo spin echo
- IV: Intravenous
- K: Kidney
- L: Lumber
- LK: Left Kidney
- m SENSE: modified sensitivity encoding
- MCDC: Medullary cystic disease complex
- MCKD: Multicystic dysplastic kidney disease
- Min: minute
- ml : Milli-littter
- mm: Milli-meter
- MRI: Magnetic Resonance Imaging
- MSK : Medullary sponge kidney
- NPHP: Juvenile Nephronophthisis
- PD: proton density
- RCC: Renal cell carcinoma
- RF : Radiofrequency
- RK: Right kidney
- ROI: Region of interest
- SC : Sickle cell
- SE: Spin echo

- Sec : second
- SENSE: Sensitivity encoding for Fast MRI
- SI: Signal intensity
- SNR : Signal to Noise Ratio
- STIR: Short time inversion recovery
- T.S: Tuberous sclerosis
- T: Thoracic
- TCC: Transitional cell carcinoma
- TE : Time of Echo
- TR: Time of Repetition
- TS: Time of scanning
- Um: micro meter
- VHL : Von Hippel-Lindau

Introduction

Introduction:-

Sonography may incidentally detect a cystic or solid renal mass. CT and MRI are the primary investigative tools for diagnosing, characterizing, and staging renal masses. The density or intensity on unenhanced imaging and the enhancement characteristics have been used in determining the nature of renal masses. For cystic renal lesions, the Bosniak classification system stratifies the CT or MR appearances with the risk of malignancy **[Kumaresan et al.,2010]**. More recently, differences in enhancement characteristics of clear cell renal cancer from papillary renal cell cancer have been reported **[Sun MR et al., 2009]**. Despite these developments, there remain many cases for which imaging tests cannot easily differentiate benign from malignant lesions. Studies have shown that 16–33% of nephrectomies are performed on benign lesions **[Kutikov et al., 2006]**.

Diffusion-weighted imaging (DWI) has been extensively used in neuroradiology for differentiating benign from malignant brain tumors and determining the grade of astrocytoma **[Kono et al., 2001]**. Diffusion of water molecules is reduced in the intracellular space compared with the extracellular space. Thus, highly cellular tumors may be more likely to have restricted diffusion than less cellular tumors. This concept is supported by findings in brain, prostate gland, and breast neoplasms **[Yamashita et al.,2009]**.

The applications of DWI in abdominal disease have lagged behind neurologic applications. It is possible to differentiate benign hepatic lesions, such as cysts and hemangiomas, from other lesions using DWI **[Bruegel et al., 2008]**, although discrimination of benign solid tumors, such as focal nodular hyperplasia, from malignant tumors, such as hepatocellular cancer, remains problematic **[Zhang J et al., 2008].** Noninvasive methods of determining the malignant potential of renal masses are useful because the choice of treatment varies between reassurance of the patient, radiologic follow-up, ablative procedures, partial nephrectomy, and radical nephrectomy. The prognosis of different histologic subtypes of renal cancer varies and affects preoperative patient counseling as well as management. In addition, some patients with renal masses have renal functional impairment, contraindicating the use of gadolinium, and unenhanced imaging techniques would be of particular help in evaluating such patients. **(Taouli et al., 2009).** DWI is a useful tool in the evaluation of renal masses, particularly in differentiating cystic benign lesions from cystic renal cell cancer. In some patients, ADC measurements may be helpful in the histologic subtyping of renal cell cancer. DWI is likely to be particularly useful with those in whom the use of gadolinium is contraindicated. **[Kumaresan et al.,2010]**.

The aim of work

The objective of this study is to highlight the value of diffusion-weighted imaging in differentiating various subgroups of renal masses.

Gross anatomy of the kidney

Gross anatomy of the kidney

Location and External Anatomy

1. The bean-shaped kidneys lie in a retroperitoneal position (between the dorsal body wall and the parietal peritoneum) in the superior lumbar region **(Fig. 1,2).** Extending approximately from T12 to L3, The kidneys receive some protection from the lower part of the rib cage **(Figure 1b).** The right kidney is crowded by the liver and lies slightly lower than the left. An adult's kidney has a mass of about 150 g (5 ounces) and its average dimensions are 12 cm long, 6 cm wide, and 3 cm thick— about the size of a large bar of soap. The lateral surface is convex. The medial surface is concave and has a vertical cleft called the renal hilum that leads into an internal space within the kidney called the renal sinus. The ureter, renal blood vessels, lymphatics, and nerves all join each kidney at the hilum and occupy the sinus. Atop each kidney is an adrenal (or suprarenal) gland, an endocrine gland that is functionally unrelated to the kidney. ***(Marieb,2013).***

Three layers of supportive tissue surround each kidney **(Figure1a):**

2. **The renal fascia**, an outer layer of dense fibrous connective tissue that anchors the kidney and the adrenal gland to surrounding structures
3. **The perirenal fat capsule**, a fatty mass that surrounds the kidney and cushions it against blows

4. **The fibrous capsule**, a transparent capsule that prevents infections in surrounding regions from spreading to the kidney ***(Marieb,2013).***

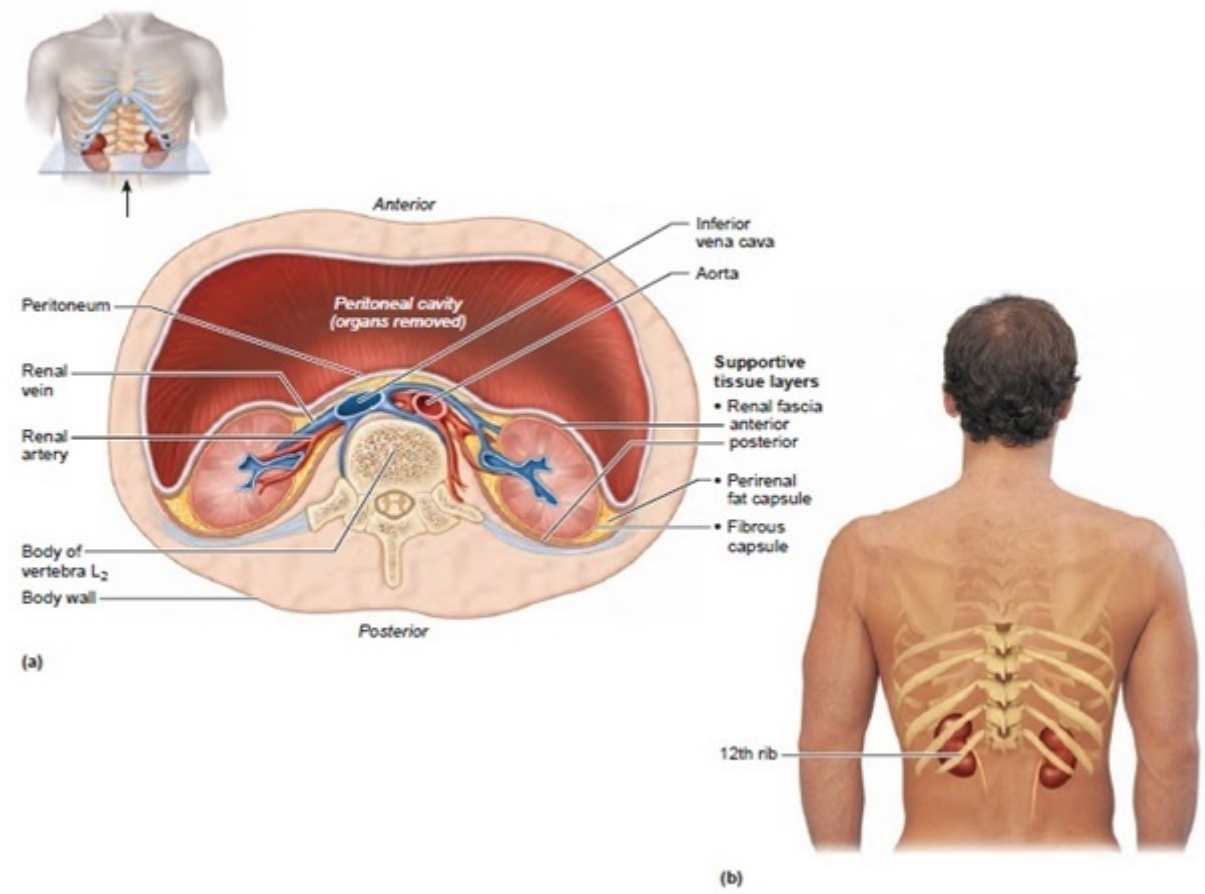

Figure 1: position of the kidneys against the posterior body wall (a) cross section viewed from inferior direction . note the retroperitoneal position and supportive tissue layers of the kidneys (b)posterior in situ view showing relationship of the kidneys to the 12th rib pairs. **(Quoted from Marieb,2013).**

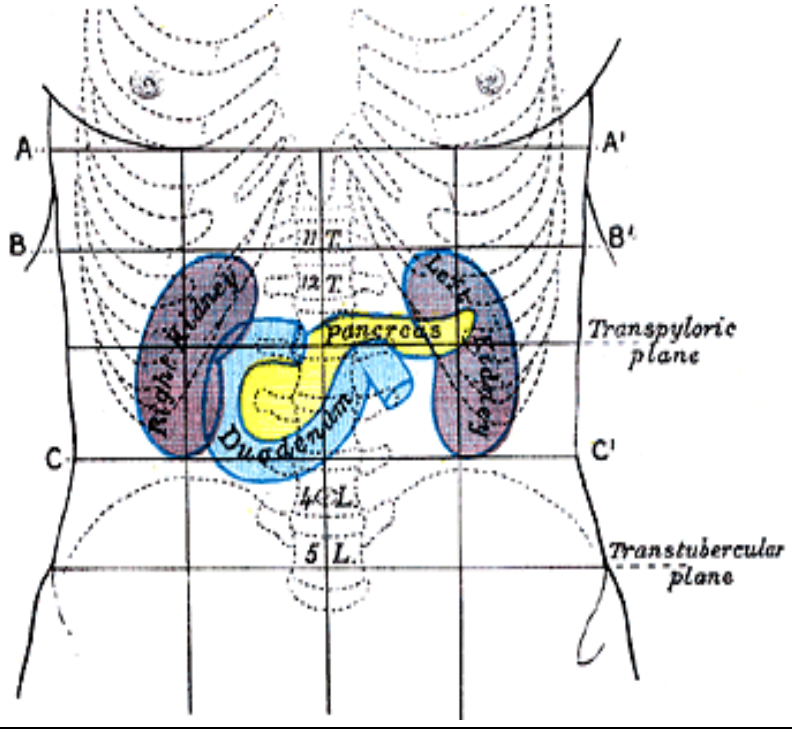

Figure 2: Front of abdomen, showing surface markings for duodenum,pancreas,and kidneys. AA; plane through point between body and xiphoid process of sternum. BB; plane midway bet. *AA,* and transpyloric plan. CC; plane midway between transpyoric and transtubercular planes ***(Quoted from Williams et al , 1995***).