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Research Article

Role of Diffusion–Weight MRI in Differential Diagnosis of Cerebral Cystic Lesions: A Prospective Study

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ABSTRACT

This study aimed to determine whether diffusion–weight MRI images and ADC (Apparent Diffusion Coefficient) could help accurately in distinguishing cystic cerebral lesions. The study included 65 patients with clinically suspected cerebral masses. They underwent surgery and diagnosed histologically. A conventional MRI was carried out on a 1.5T system using T1, T2 and fat-suppressed T1-weighted sequences before and after intravenous injection of gadolinium and echo-planar spin-echo sequence diffusion weight and ADC is carried for all patients. All MR imaging features were categorized cerebral cystic lesions without knowledge of clinical details, according to the imaging features which were compared with the surgical and pathological findings. The diagnosis was confirmed with surgery and histological evaluation which included 30(48%) patients with primary cystic brain tumors, 19 (35%) with metastatic tumors and 11 (17%) with abscess. All abscess cavities showed hyper intense DWI signal intensity and low signal ADC so the sensitivity for diagnosis abscess in DWI are 100%, while in primary brain tumor only 1 from 10 cystic glioma show hyper intense on DWI and hypo intense on ADC while the remain cystic glioma 9 show hypo intense on DWI and hyper intense on ADC make the sensitivity of DWI foe diagnosis primary malignant cystic tumor 90%. The study concluded that diffusion –weight MRI and ADC is sensitive for characterizing cystic cerebral lesions.

Keywords: Magnetic resonance imaging (MRI), diffusion weight, ADC (apparent diffusion coefficient), Cerebral lesion, sensitivity, specificity.

INTRODUCTION

The normal brain and most disease of brain diffusion weight MR is used, the brain tumor with development technique area capable of grading the tumor *in vivo*[1]. The histologic grading of gliomas and response to treatment can be study with diffusion –weight MR imaging[2,3]. The typical benign meningioma area easily diagnosed and difficult to distinguish from more malignant histologic grades by CT (computed tomography) or conventional MR imaging, the neuroimaging features, such as irregularity, perilesional edema,a ppearance heterogeneous or not, bone destruction, outer edge of tumor and appearance of enhancement are not reliable for diagnosing malignant and atypical meningioma[4] . The newly brain tumors identified by imaging characterization may indicate the diagnosis and management, there is certain cases of metastatic brain tumors and glioblastpma were often considered untreatable[5,6]. There is typical MRI protocol for preoperative brain tumor assessing include T1 weighted with gadolinium enhanced,T2 weighted and diffusion weighted to evaluate the lesion, vascularity, irregularity and blood brain barrier integrity these sequence result in correct diagnosis in majority of cases[7,8]. The Aim of this study: the objective of study to see if the diffusion –weight magnetic resonance imaging (MRI) and apparent diffusion coefficient (ADC) can be differentiate cystic cerebral lesions on the basis of their morphologic features.

MATERIALS AND METHODS

Between January 2014 and August 2016, 65 patients (mean age 55 years, range 25 to 80 years) with clinically suspected cystic cerebral mass were prospectively studied. Five patients excluded from this study because they refuse to do surgery. The remaining patients underwent surgery and diagnosed histologically. The patients underwent preoperative conventional MRI and diffusion-weight MRI in department of radiology in Hila teaching hospital followed by operative exploration, all cases were done in department of surgery in the same hospital. The median time from scanning to surgery was 35 days (range, 2 days to 70 days) between initial MRI and surgery. A conventional MRI was carried out on a 1.5T system using T1, T2 and fat-suppressed T1-weighted sequences before and after intravenous injection of gadolinium and echo-planar spin-echo sequence diffusion weight is carried for all patients. All MR imaging features were categorized as benign or malignant without knowledge of clinical details, according to the imaging features which were compared with the surgical and pathological findings. MRI performed with multiplanar sequence with fat suppression technique we used T1 and T2 with different planes (axial, sagittal and coronal) see the cerebral lesion whether sold or cystic, intensity, texture, homogeneity, site of mass and see for soft tissue extension and metastasis we used two

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Table 1: Clinical presentation of the patients.

Clinical feature	No.
headache	42(70%)
Dizziness	12(20%)
Confusion	6 (10%)
total	60(100%)

Table 2: Distribution of cerebral masses in relation to age of the patients.

Age	No. (%)
20-30years	3 (5%)
30-40 years	6 (10%)
40-50years	9 (15%)
50-60 years	20(33.4%)
60-70 years	12 (20%)
70-80 years	7 (11.6%)
80-85 years	3 (5%)
total	60 (100%)

Table 3: Histopathological type of cystic cerebral masses

type	No. (%)
Primary cystic brain tumors	30(48%)
Metastatic tumor	19(35 %)
abscess	11(17%)
total	60(100%)

radiologist to see the MRI without known the clinical feature of subjects. There is some patients about 5 patients excluded from this study the refuse to do surgical exploration or that do surgery before 6 month in this study enter. Protocol of MRI included using MRI 1.5 T units of Philips system, used mtiplanar sequence with different coils for imaging of brain, and diffusion weight with ADC do for all patients.

RESULTS

Sixty subjects with different signs and symptoms were admitted to Hilla teaching hospital, Iraq (Table 1). The age of the patients enrolled in this study ranged from 25-80 years with mean age 55 year (Table 2). Conventional MRI examination was done for all patients to investigate whether they have cerebral mass or not and if present, the size, appearance and the presence calcification (or absent) of the mass, were also investigated. DWI and ADC (Apparent Diffusion Coefficient) examination was also done for all patients to investigate in department of radiology in Hila teaching hospital, followed by operative exploration in department of surgery in the same hospital during period between January 2014 and February 2016. All patients underwent operative exploration with histopathological examination and compare with preoperative MRI examination. Regarding the sizes of mass range from 1-11 cm. In all 60 patients, the diagnosis was confirmed with surgical and histological evaluation which included 30 (48%) patients with primary cystic brain tumors, 19 (35%) with metastatic tumors, and 11 (17%) with abscess. Table-3 shows the histopathlogical findings of cerebral masses in the patients. Majority of cerebral a lesions 39 (39%) were found in males and 21(20%) of cerebral lesion found in females. The primary cystic brain tumors include cystic glioma in 10 patients, arachnoid cyst in 11 patients and 9 patient have epidermoid cyst. All abscess cavities showed hyper intense DWI signal intensity and low signal ADC (Fig.1 and Fig.2) so the sensitivity for diagnosis abscess in DWI was 100%, while in primary brain tumor only 1 from 10 cystic glioma showed hyper intense on DWI and hypo intense on ADC, while the remaining cystic glioma, 9 showed hypointense on DWI and hyper intense on ADC making the sensitivity of DWI for diagnosis of primary malignant cystic tumor 90%. All primary benign brain tumors (arachnoid cyst and epidermoid cyst) can diagnosed by DWI and ADC. In metastatic tumors, 5 out of 19 metastatic tumors showed hyper intense on DWI and hypo intense on ADC while the remaining showed hypo intense on DWI and hyper intense on ADC.

DISCUSSION

The clinical application of DWI (diffusion weight MRI) started in last decade with show anatomy of the white matter fiber tracts in the brain, there are two approach, the first one consists of reconstruction of images for possible area increase or decrease signal, the second one reconstruction of image maps of the apparent diffusion coefficient (ADC), in which the T2 weighting of the echo planar diffusion sequence is delete and theory objective (numerical) evaluation with regions of interest[9]. The differentiating between cystic brain tumors (glioma and metastatic) and brain abscess is often difficult with conventional MRI[10] the goal of this study to evaluate the ability of diffusion weight MRI to differentiate cerebral cystic lesions. In this study, the sensitivity of DWI for diagnosis of abscess was 100% and 90% for diagnosis of primary brain tumor. This result goes with finding of Bukte[11]. DWI (diffusion –weight MR imaging) has shown promise in differentiating malignant neoplasm and brain abscess the ability of DWI to diagnosed brain abscess enables a neurosurgeon to change planning of management, all brain abscess restricted water diffusion as indicated by hyper intense on DWI and diminished on ADC this finding similar to finding by Leuthardt[12]. The study focused on primary brain tumors to differentiation between primary cystic benign tumors. Results revealed that that DWI and ADC differentiate all primary benign cystic brain tumor such as arachnoid cyst and epidermoid cyst, the arachnoid cyst had the same intensity with cerebral spinal flow in all sequence mean that low signal (dark) on DWI and high signal (bright) on ADC, while all epidermoid cyst high signal on DWI and low signal on ADC, according to this result DWI and ADC were superior to conventional MRI sequence in differentiation arachnoid cysts from epidermoid cysts[13]. Results of this study also revealed that metastatic tumors and cystic glioma have low signal on DWI and high signal in ADC, our main finding that ADC in cerebral metastasis are higher than in cystic glioma in addition oedema surrounding metastasis higher ADC than edema surrounding cystic glioma, the finding higher in ADC in metastasis than cystic gliomahelpful in distinguish between there tumors this finding similar to

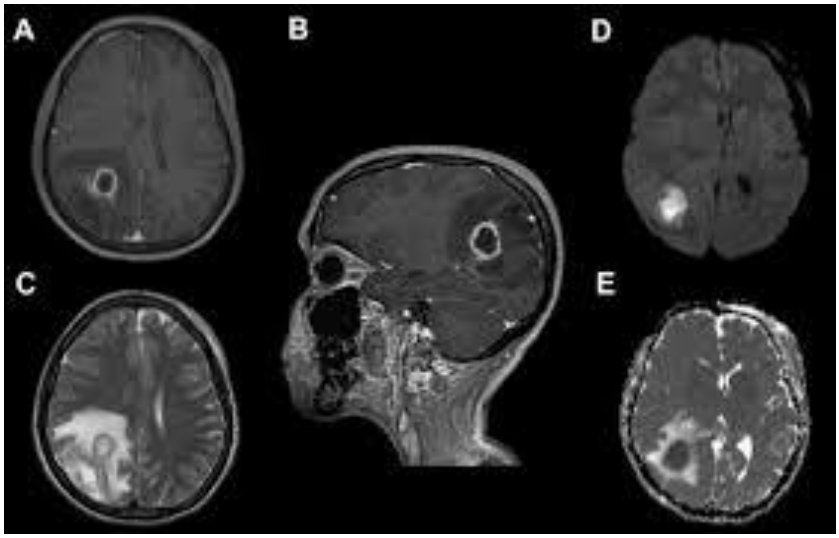

Figure 1: Brain abscess in the right parietal lobe. A and B. T1-weighted image axial and sagittal with intravenous contrast medium contrast, the abscess shows ring enhancement. C. T2-weighted image the abscess mixed intensity (from low to high) with peri- lesion edema. D. on DWI, the brain abscess high signal and edema low signal. E. the ADC shows the brain abscess low signal and edema high signal.

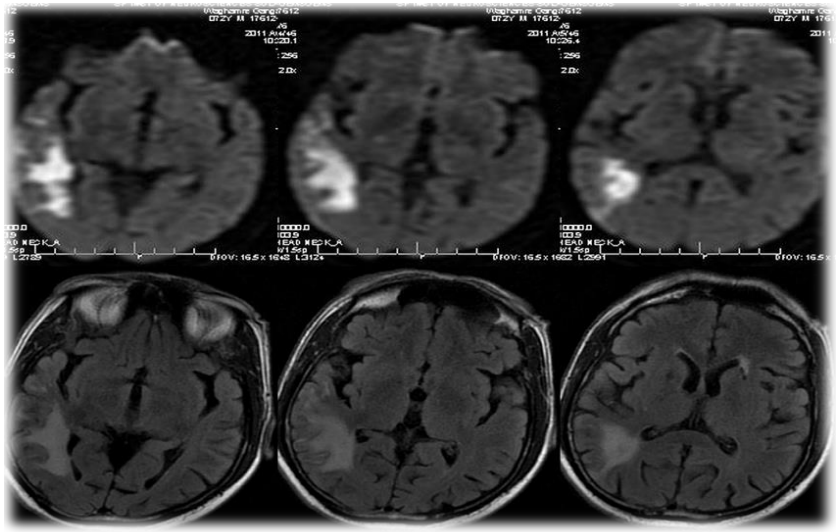

Figure 2: Brain abscess shows high signal on DWI and iso intense signal on T1 –weighted image.

Table 4: Signal intensity of cystic cerebral lesions on DWI and ADC

Type of cerebral lesions	Number	DWI	ADC
abscess	N=11	High signal	Low signal
	N=0	Low signal	High signal
Metastatic tumors	N=14	Low signal	High signal
	N=5	High signal	Low signal
Cystic glioma	N=9	Low signal	High signal
	N=1	High signal	low signal
Arachnoid cyst	N=11	Low signal	High signal
	N=0		
Epidermoid	N=9	High signal	Low signal
	N=0		
Total	60		

finding by Krabbe[14]. The results of this study showed that diffusion weighted MR and ADC have an important role in the differential diagnosis between brain abscess and cystic tumor and between arachnoid cyst and epidermoid cyst according to signal intensity depend on water restriction, however the accuracy depends only on biopsy.

CONCLUSION

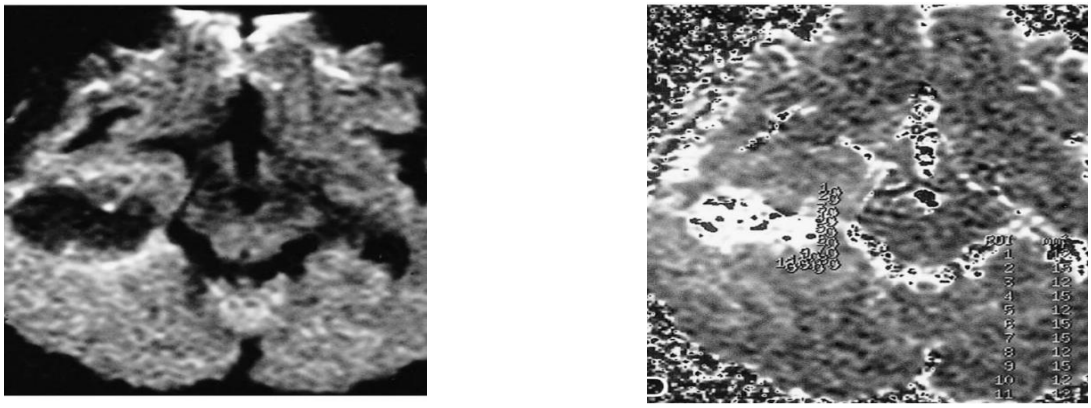

Figure 3: Cystic glioma in right temporal lobe.

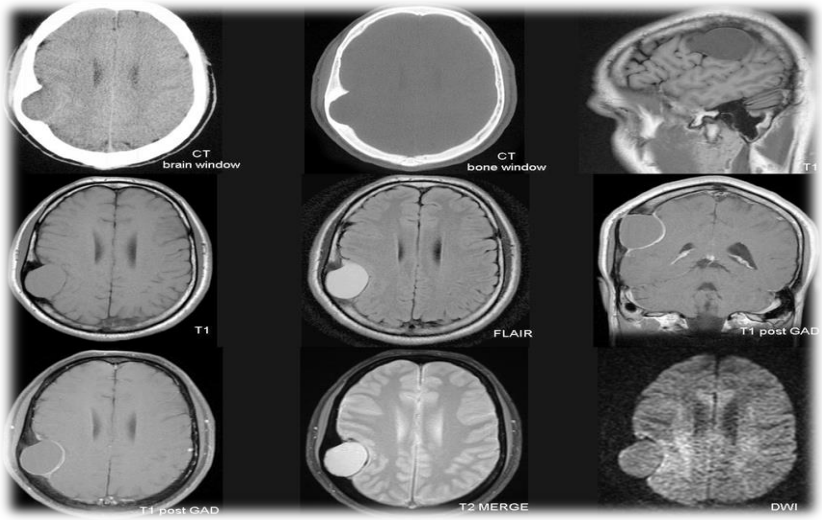

Figure 4: Arachnoid cyst in right parietal lobe.

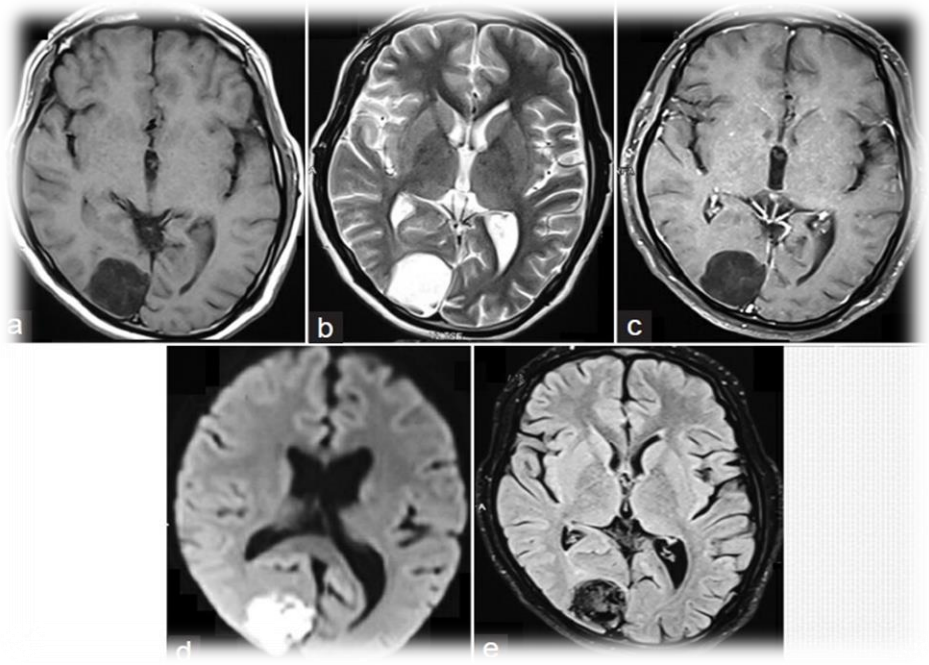

Figure 5: Epidermoid cyst in right occipital lobe.

On the basis of the findings, the study concluded that diffusion–weight MRI is sensitive for differentiation cerebral cystic lesions and it allows the differentiation of cystic brain tumors from brain abscess making it strongly modality of imaging in the early diagnosis of these entities. Thus, imaging findings may contribute incremental value to clinical parameters in providing prognostic information, consequently improving the quality of the data used in therapeutic planning.

Figure 6: Metastatic tumor from lung cancer in left occipital lobe. on DWI show low signal surrounding by high signal edema.

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CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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