

Original Research Article

The Validity of Diffusion–Weight MRI in Differentiation Cystic Brain Tumors From Brain Abscess (Prospective Study)

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Abstract

To determine the ability of diffusion–weight MRI images and ADC (apparent diffusion coefficient) to differentiation brain tumors from brain abscess which are difficult to distinguish on conventional MRI technique. From May 2015 to march 2017, prospectively studied 50 patients (age range 20 to 85years, mean age 55 years) with diagnosis clinically brain tumor or abscess. A conventional MRI was done on Philips MRI a 1.5T using T2, T1 and fat-suppressed technique and echo-planar spin-echo sequence diffusion weight and ADC is carried for all patients. All MR imaging features were categorized brain lesion as brain tumor or abscess , according to the features of imaging which were compared the result with histopathological findings. Fifty patients, 29 male and 21 female the diagnosis was confirmed with pathological findings which included Primary malignant cystic brain tumors 10(20%) Primary benign cystic brain tumor 13 (26%), Metastatic tumor16 (32%) and abscess11 (22%).the sensitivity for diagnosis abscess in DWI are 100%, for diagnosis primary malignant cystic tumor 60%, Primary benign cystic brain tumor 100% and the sensitivity of DWI foe diagnosis metastasis tumor 81%. Diffusion –weight MRI and ADC is good modality for differentiation cystic necrotic tumor from brain abscess.

Key Words: Resonance imaging, Diffusion–Weight, Magnetic, ADC (apparent diffusion coefficient) specificity, tumors of brain.

صلاحية الانتشار-التصوير المرجح لدراسة التصوير بالرنين المغناطيسي في التفريق بين الورم الدماغي والخراج الدماغي

الخلاصة

اجريت دراسة مقطعية لخمسين مريضاً يشتبه بإصابتهم بالورم الدماغي او الخراج الدماغي ،تم فحصهم بالرنين المغناطيسي لتشخيص كون الورم كيسياً أم صلباً، تم إجراء الانتشار الرنين المغناطيسي للتفريق بين الورم الدماغي والخراج الدماغي قبل العملية، حيث اعتبرت المعايير الآتية اساس في التمييز كون التكتل بالدماغ ورم أم خراج (نوعياً ودرجة الانتشار ، فليليته على تحديد الكثافة ،وقياس درجة الكثافة) أظهرت هذه الدراسة ان التكتل الذي يحتوي على الخراج بعد اجراء انتشار الرنين المغناطيسي له يمكن تشخيصه بان له قابليه على تحديد الكثافة بينما الورم الخبيث له قابليه مختلفة لأخذ الكثافة إن نسبه تشخيص الخراج الدماغي ١٠٠% بينما نسبه تشخيص الورم الدماغي السرطاني ٦٠% بينما نسبه تشخيص الورم الدماغي الحميد الكيسي ١٠٠% بالاضافه إلى ذلك نستنتج من هذه الدراسة إن الانتشار الرنين المغناطيسي له قابليه علي تمييز لكون التكتل الدماغي ورم أم خراج.

الكلمات المفتاحية:الرنين المغناطيسي، انتشار الرنين المغناطيسي، أورام الدماغ، الخراج الدماغي.

Introduction

The abscess of brain during MRI examination vary with stage of lesions, there are several stages of brain abscess in the last stage the capsule is

become as thin walled hyper intense ring on unenhanced scan that becomes hypo intense on T2-weighted [1]. On imaging studies, high grade gliomas after contrast are enhanced strongly and show edema in

peritumoral, whereas, except for low-grade gliomas usually show no peritumoral edema and contrast enhancement. Differentiation of these two types of tumors may be difficult, because low-grade astrocytoma also may show contrast enhancement [2].

Diffusion –weighted MR has an establish role in the differential diagnosis between brain abscess, cystic tumor and between epidremoid cyst and arachnoid cyst [3,4].

There is protocol for typical MRI in preoperative assessing tumor of brain include T2 and T1 weighted, diffusion weighted to evaluate the lesion T1 weighted with gadolinium enhanced, , blood brain barrier integrity, irregularity and vascularity these sequence result in correct diagnosis in majority of cases [5,6].

The aim of this study was to investigate whether the brain tumors can be differentiated from brain abscess in diffusion –weight (MRI) and apparent diffusion coefficient (ADC) on the basis of their appearance and characterization of signal intensity.

Materials and Methods

In department of surgery in Hilla teaching hospital, Iraq, a prospective studied 50 subjects with different age range from 20-85 years, mean age 50 years have different clinical presentation Fig. (1). With clinically suspected brain mass whether tumor of abscess, all patients do conventional MRI preoperative and the do diffusion –weighted MRI to show characterization of signal intensity in period extended from May 2015 to march 2017, two radiologist see the MRI pictures to differentiation the brain mass whether tumor of abscess followed by operative exploration in the same hospital, the median time between initial MRI and surgery 30 days (range 4 days to 73 days).

Magnetic resonance imaging (MRI) was carried out on a Philips 1.5T system using multiplanar sequence T2, T1 and fat-saturation and sequence diffusion weight is carried for all subjects. All MR imaging features were categorized according to the features of imaging as malignant or benign without clinical details.

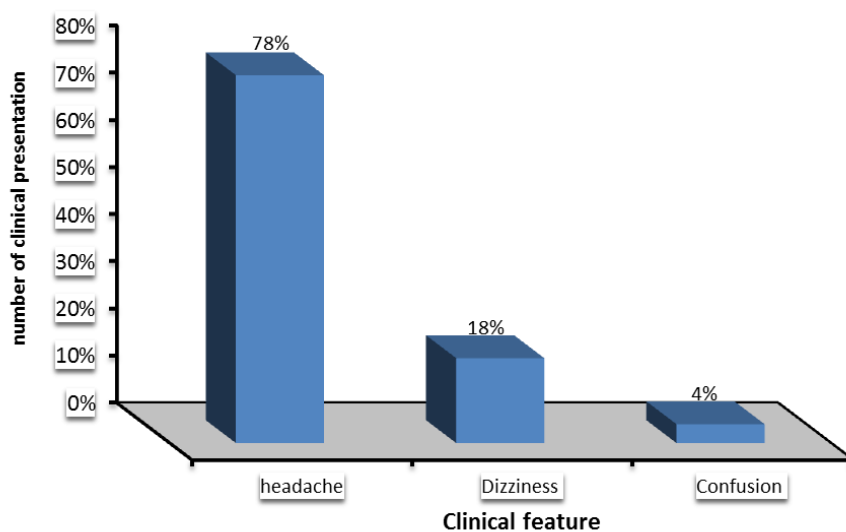


Figure 1: Clinical presentation of patients enrolled in the study

MRI Protocol

In this study used Philips MRI 1.5 T units, with different planes (coronal, sagittal and axial) see the brain lesion whether cystic or solid, site, texture, extension, and intensity. Used mtiplanar sequence diffusion weight with ADC do for all patients. In this study, the thickness of slice was 5 mm and the slices numbers averaged

14, which decrease the effects of eventual motion and volume partial between diffusion-weighted imaging and conventional MR.

Results

Fifty subjects admitted in teaching hospital in Babylon in Iraq have different symptom and signs. In this study, age of

patients included ranged from 25-85 years mean age (55 year) Fig. (2), 29 male and 21 female **Fig. (3)**, then routine conventional MRI examination was done, in conventional MRI examination show the patient normal or abnormal, if there is mass in brain or not, the abnormal patient who have cystic mass in brain do DW MRI in department of radiology in the same hospital to determine the mass, appearance of mass, nature and side then do ADC (apparent diffusion coefficient), the appearance of MRI are read by two radiologist without known history of patient to determine the diagnosis and mention the report ,then all patient do surgery in in the same hospital. In all 50 patients the diagnosis was confirmed with histological evaluation which include primary benign cystic tumor 10 (20%), have primary malignant brain tumor (cystic glioma) 13 (26%), patients have metastatic tumors 16 (32 %) and 11(22%) have abscess as shown in Fig. (4).

All primary benign cystic brain tumors (arachnoid cyst and epidermoid cyst) can

diagnosed by DWI and ADC show high signal on DW MRI and low signal on ADC, so the sensitivity for diagnosis arachnoid cyst and epidermoid cyst on DW MRI are 100%.

The sensitivity for diagnosis abscess in DWI are 100%, All abscess cavities showed hyper intense DWI signal intensity and low signal on ADC Fig. (5, 6), while in primary cystic malignant brain tumor only 4 from 10 primary malignant cystic brain tumor show hyper intense on DWI and hypo intense on ADC while the remain primary cystic tumor 6 show hypo intense on DWI and hyper intense on ADC Fig. (7) make the sensitivity of DWI foe diagnosis primary malignant cystic tumor 60%, in metastatic tumors 3 out of 16 metastatic tumors show hyper intense on DWI and hypo intense on ADC Fig. (8) while the remain showed hypo intense on DWI and hyper intense on ADC make the sensitivity of DWI foe diagnosis metastasis tumor 81%. as shown in Fig. (9, 10).

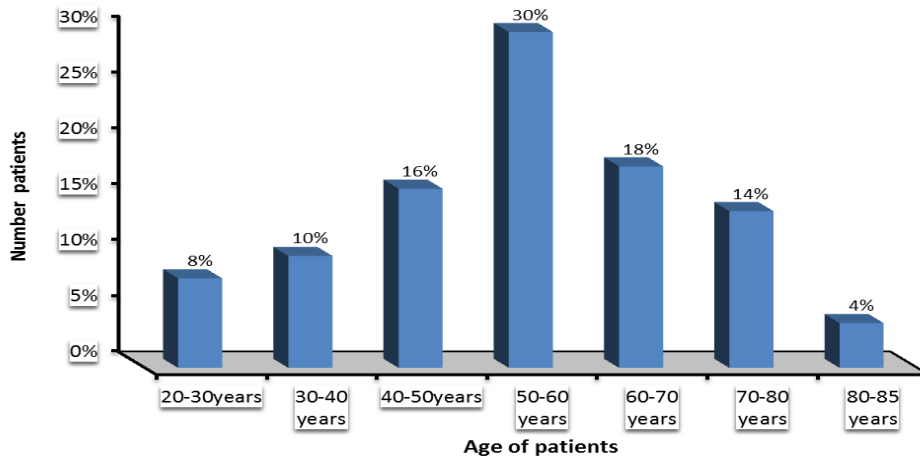


Figure 2 : Distribution of cerebral mass in relation to age of patients

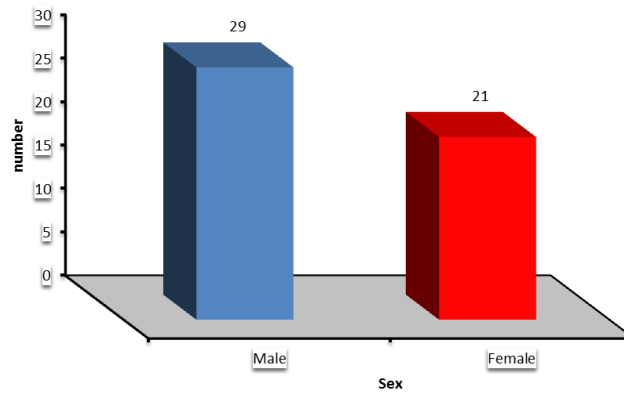


Figure 3: Distribution of brain lesions in relation to sex

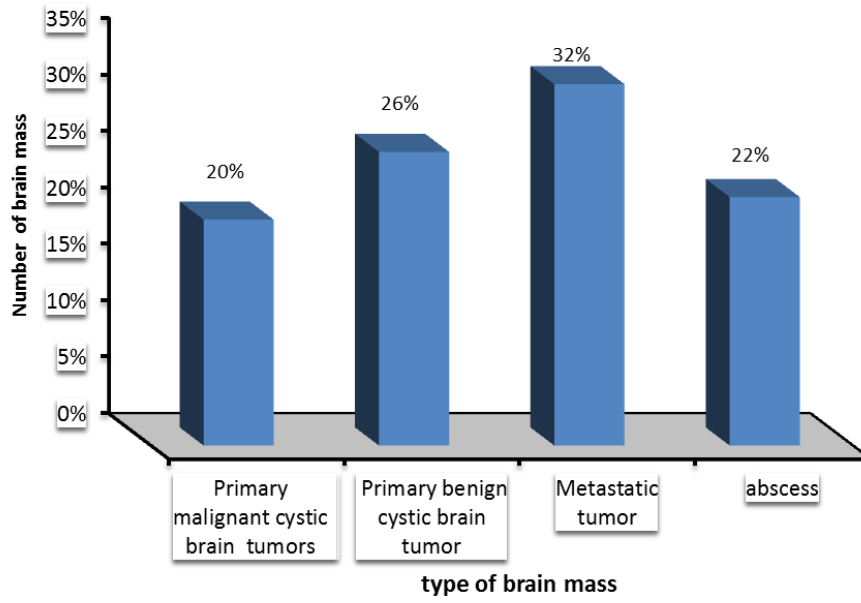
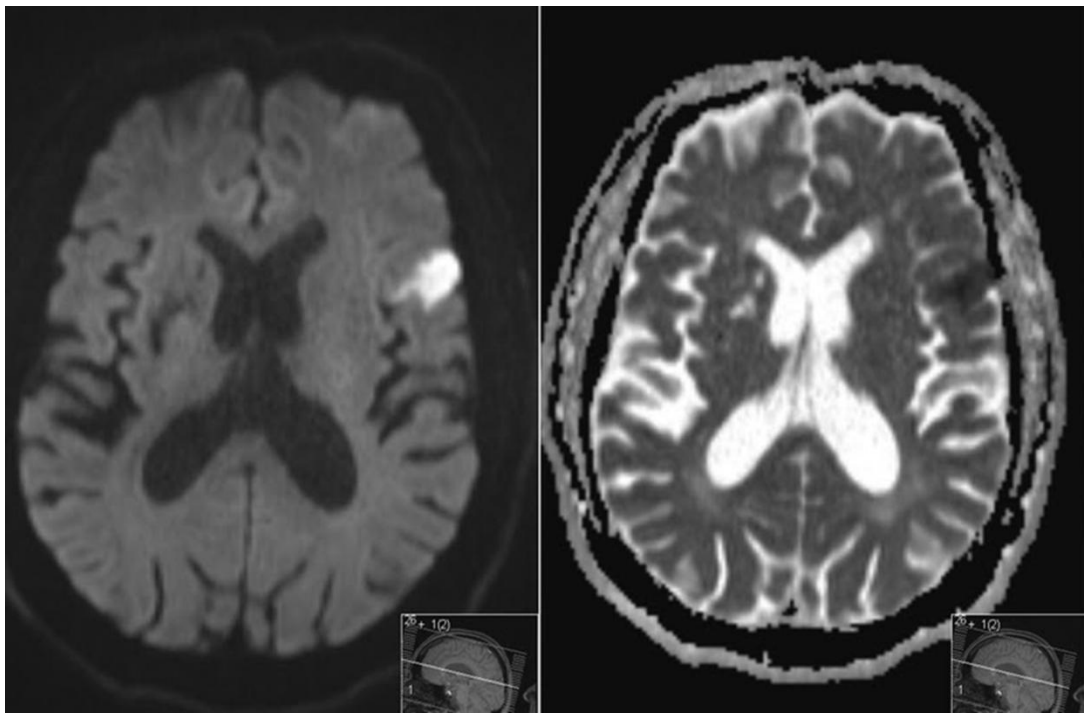


Figure 4: Histological type of brain mass



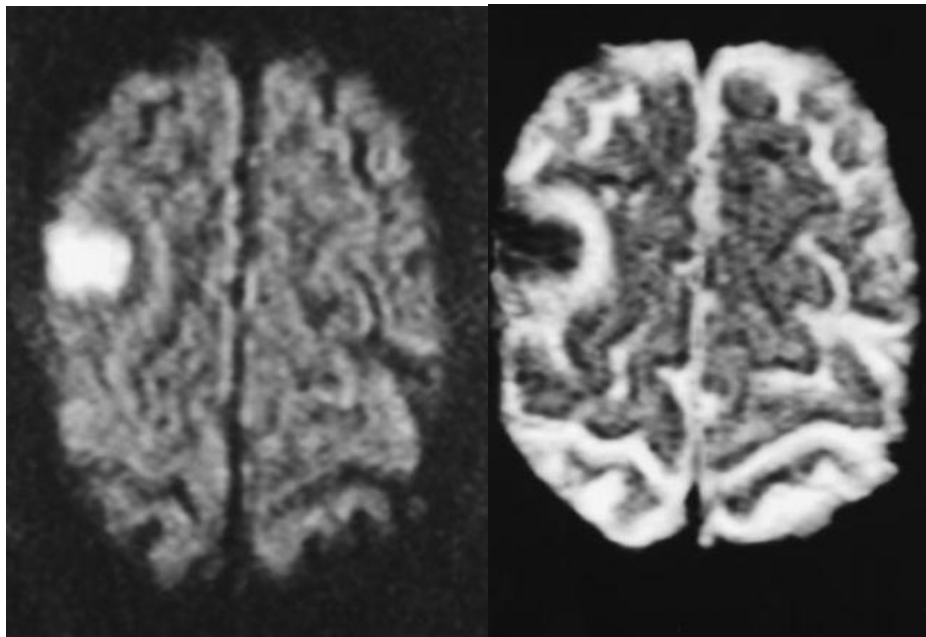
A

B

Figure 5: brain abscess in the left parietal lobe

A. on DWI, the brain abscess high signal.

B. the ADC shows the brain abscess low signal.



A

B

Figure 6: Brain abscess shows: A- High signal on DWI;B- low signal on ADC

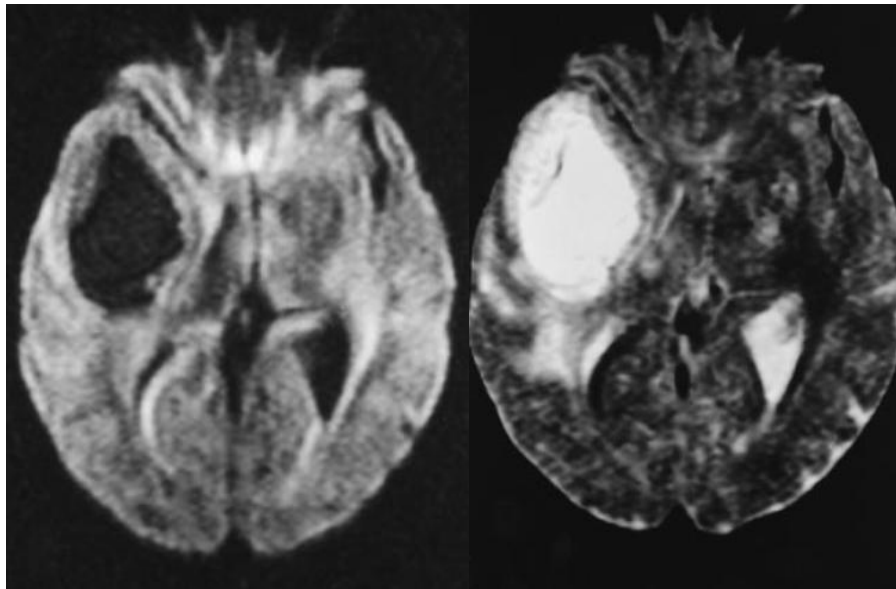


Figure 7: Cystic glioma in right temporal lobe

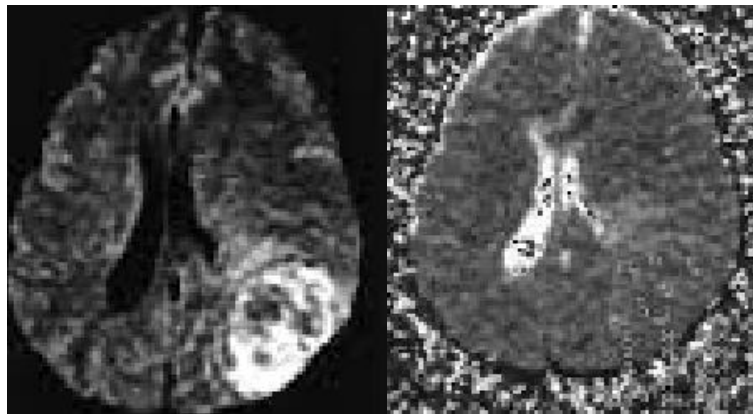


Figure 8: Metastatic tumor from lung cancer in left occipital lobe on DWI shows low signal surrounding by high signal edema

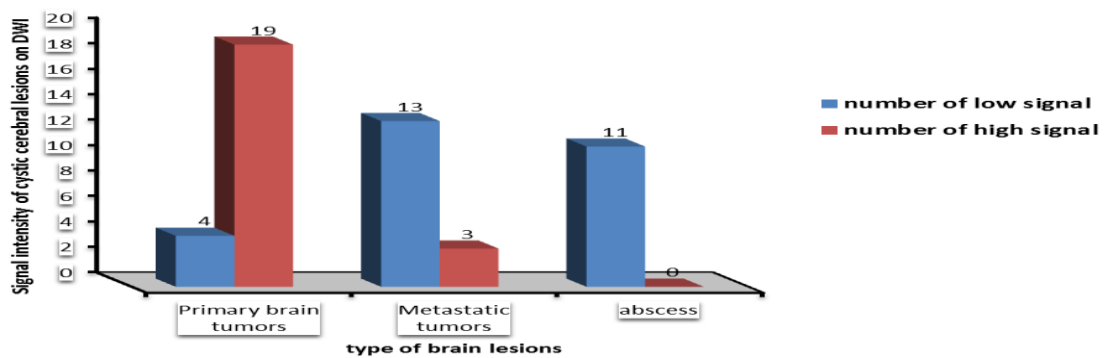


Figure 9: Signal intensity of cystic cerebral lesions on DWI

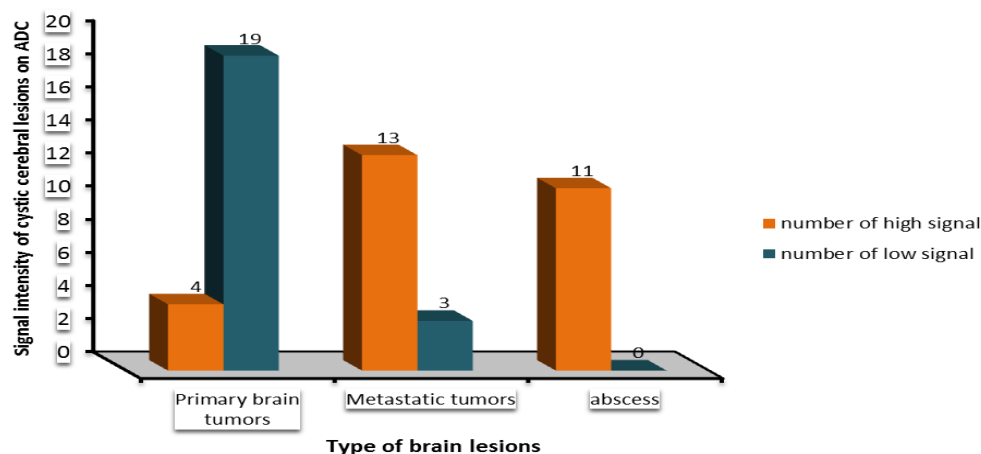


Figure 10: Signal intensity of cystic cerebral lesions on ADC

Discussion

MRI is a good module using multiple relaxation properties seen in tissue types to provide information on content of masses of soft tissue, the result of this information show the character of masses of soft tissue [7, 8]. Diffusion-weighted MR imaging is found to be highly specific and sensitive for the diagnosis of cerebral infarction in acute stage [9, 10].

The brain tumor characterize by clinical routine MRI by appearance on T1 and T2-weighted images and after contrast examination. In brain tumors due local breakdown of the blood-brain barrier the mechanism of T₂-weighted enhancement after injection of contrast. However, leaking blood-brain barrier and the contrast agent enhancement is not always associated with tumor growth; it could be due to tumor tissue, increased permeability of blood vessels, inflammation or other abnormal changes. Diffusion weighted MRI depend on fluid pool restricted [11, 12].

In this study we focused on ability of DWI and ADC to characterize necrotic tissue from water content of brain mass that DAI restricted all water in abscess causing the abscess high signal on it and low signal on ADC this finding similar to finding by several reports [4, 11].

In this study the sensitivity of DWI for diagnosis abscess are 100 % ,for diagnosis primary benign cystic brain tumor

(arachnoid and epidermoid cyst) are 100 % this result goes with finding of several reports [4,13].

In tumor lesion presence large areas of necrosis can be well detected on the elevated ADC [17]. One of the early reported applications of diffusion imaging in brain tumors diagnosis was the differentiation between primary benign epidermoid and extra-axial cysts [18]. In our study found Diffusion-weighted imaging is good modality for distinguishing brain abscess from cystic or necrotic tumor lesions, is more best than performing conventional MRI alone the finding similar to finding by Chang [19].

In this study patients were classified into fourth main groups; first group. Is cystic or necrotic malignant brain tumors, (10 cases) of high grade necrotic glioma, second group brain abscesses (11 cases),and third group is benign cystic masses, arachnoid and epidermoid cysts (13 cases) and 4th group metastatic cystic tumor (16 cases).

On visual assessment, all brain abscesses showed ring enhancement at post contrast T1 weighted images and brain abscesses are hyper intense on DWI and hypo intense on ADC maps (restricted diffusion) make the sensitivity of diffusion weighted for diagnosis brain abscess 100% this result similar to finding by Leuthardt [20].

In our study, 10 patients of cystic malignant brain tumors of different Pathological types

were involved, 6 cases of them (60%) are free diffusion and 4 cases (40 %) are restricted diffusion, make the sensitivity of diffusion-weighted MRI for diagnosis cystic malignant brain tumor 60%, In this study 10 cases of cystic metastatic space occupying lesions, 8 of them (80%) are free diffusion and 2 cases are restricted diffusion (20%) this result similar to finding by Yousef [21]. 13 extra-axial cystic benign lesions, 8 arachnoid cysts appear hypointense on DWI and hyper intense on ADC maps and 5 cases are epidermoid cysts are hyperintense on DWI and hypo intense on ADC maps this result make the sensitivity of diffusion weighted MRI 100 % this result similar to finding by Lai [22].

Conclusion

There is widely applied of Diffusion-weighted MRI imaging for diagnosis of various diseases including the detection of cystic brain tumors from abscess, and distinguishing arachnoid from epidermoid cysts. Diffusion imaging can follow up of brain abscess after antibiotic therapy or surgical interference and aid in the diagnosis. This sequence should be used as addition to routine imaging and not avoid histopathology.

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